THE

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ELECTRICAL REVIEW.

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THE

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TEMPORARY WIRING IN BALL ROOMS, &c.

OUR views regarding the exaggerations as to electrical fire risks that appear from time to time in the daily Press are well known. We strongly resent the tendency that exists in some quarters to wrongfully attribute fires to electrical causes. On the other hand, when instances come before us of apparent slipshod work involving risk of fire, we cannot but impress upon our readers the mischief that can be done by not taking reasonable precautions.

The action by Mr. Lionel Phillips, of Grosvenor Square, against a firm of caterers, which we have reported at some length, is certainly an instance which should serve as an object lesson to electrical contractors, but even more so to the many firms of the catering, draper and general middleman type, who believe they can undertake electrical contracts with the same facility as it is possible to sell matches on a street pavement.

In this case we have a wealthy gentleman desirous of giving a party, and he instructs his caterer to erect a temporary supper room of the usual wood and canvas construction, and to light it with electricity. He does not bargain about the price, and he gives the caterer a free hand. The latter accepts the order and promptly sub-contracts his tent work and electric lighting, without, as far as we are aware, even having as much as an electrical engineer or a consulting engineer at call to see that the work for which he is responsible is done in a careful manner. The risk of fire apparently does not enter into his mind. He has his canvas building put up entirely of inflammable materials; it is then wired for electric lighting, miniature 5-C.P. lamps being applied on the looping system in garlands round the room. He then lines the building with muslin, and drapes muslin in close proximity to these garlands. The muslin is in no way treated to be flame-proof, and the caterer put into the witness box his sub-contractors' foreman, who actually states that he does not know that ordinary muslin will burn. In the ordinary course the electrical insulation is tested by the Supply Co., as far as the lighting circuits are concerned, but after the inspector has left, some alterations are still made in the way of fitting up some large electric fans.

A fire breaks out a few hours before the party, immediately after the place has been lighted up for a trial demonstration. No one appears to have actually seen the outbreak. The flames spread very rapidly, as is only to be expected, and the temporary room is entirely gutted and considerable damage is done to the house. The Fire Brigade is called in, puts the fire out, and officially reports the cause to be an electrical one.

Mr. Lionel Phillips thereupon considers that there has been negligence; he refuses to pay for the erection of the ballroom in question—the use of which he has not had—and brings an action to recover certain damages.

D

No one apparently having seen the outbreak of fire, the onus rests with him to prove the cause to have been an electrical one, and then to show that the electric wiring was defective. It is, of course, very difficult — well-nigh impossible—to prove the cause without direct evidence being available, and although circumstantial and expert evidence was naturally very much in the direction indicated, the jury did not take the view that an electrical cause and negligence had been proved, *i.e.*, they gave the caterer the benefit of the doubt.

In the course of expert evidence great emphasis was laid on the fact that the looping system was utilised with small miniature lamps. Experts like Col. Crompton and Mr. Swinburne were most emphatic as to the dangerous character of the temporary wiring done, and we are sure most electricians would agree that this system with tiny lamps is not appropriate for risky and hurried work of this kind.

The defendants tried to show that the looping system with miniature lamps was common practice, but they failed to do this. They also tried to show that the use of non-inflammable materials round electric lamps was not customary at private entertainments, although of course it is a recognised essential at all public entertainments under the L.C.C. control. They argued that they had followed the Institution of Electrical Engineers' wiring rules as to fuses, &c., and we think they had certainly done this; but it should be borne in mind that these rules were intended for permanent work.

The general impression that the case made was, firstly, that of callousness in the direction of risk of fire, *i.e.*, that there was no thought as to the electrical risk of the fancy lighting adopted, nor any thought as to what would happen if there was a "short." This callousness went so far that there were not even any fire appliances about.

To put it plainly there was no recognition of risk at all, either on the fire preventive or fire extinguishing side.

The next point that was brought out was that, although the wiring rules of the Institution of Electrical Engineers may be excellent for permanent work, there should certainly be a supplement pointing out the necessary additional safeguards for temporary work.

Another point was to the effect that laymen contractors seem to pin their faith, in respect of questions of safety, to the ordinary insulation test conducted by the supply companies, which is, of course, a fallacy.

Lastly, it was shown that temporary buildings of this character should certainly be quite as much under the supervision of the local authorities, as, say, an ordinary temporary building of the iron shed type that has to have a licence, and is certainly of a more substantial character than a canvas one.

Altogether, the case brought some very strong points to light as to the general indifference as to question of safety in temporary work, both constructional and electrical.

We trust that those interested in this class of work will take the lesson to heart. Had the fire occurred a few hours later, loss of life must necessarily have resulted.

Regarding the Institution of Electrical Engineers, it would be well if that body gave some attention to this matter of additional precautions in temporary work.

The case was very well prepared, both sides being well up in their technical data, and Messrs. Braunstein & Skelton (solicitors to Mr. Lionel Phillips), with Colonel Crompton, had been at very great pains in the preparation of models, diagrams, and the like. We are pleased that the case was fought, and that publicity has been accorded to this subject. We certainly think it would be detrimental to the electrical trade if such occurrences became frequent, and the sooner they are put a stop to, by the realisation of additional hazards in temporary work, the better it will be for electrical progress.

Lists of Tenders.

MAY we be permitted to say that we have a strong dislike for excessive secrecy on the part of those whose duty it is to adjudicate upon public tenders. Not that we think that a detailed statement should be always issued explaining why one particular firm secured the contract and the others did not; but it certainly seems to us that where the number of tenderers is not very large a list of the firms and their prices, showing their relation to the successful figure, is due to the various firms interested, if merely as a compliment. And where the list is very lengthy the trade and technical journals are ever ready to publish it if the matter is of sufficient public interest. In many cases local authorities and committees responsible for the management of public institutions send out complete particulars; consulting engineers and architects, too, are frequently perfectly willing to furnish such information; but occasionally special resolutions are passed dictating that on no account is the list of firms and figures to be divulged for publication. Is it to be wondered at if such a decision gives rise to a certain amount of significant nodding and winking among business men who hear of it? The reasons may seem to be all right to the men who proposed or supported the resolution, but, however that may be, other people, and particularly the unsuccessful tenderers, who have no way of ascertaining where they stood in the competition—unless they take a journey of perhaps several hundreds of miles (or wait until they are in that part of the country) to inspect the one solitary copy of the official list—have their suspicions aroused, and are tempted to make suggestions which are neither palatable to themselves nor likely to be very agreeable to those of whom they entertain them. To state the matter briefly, there can hardly be too much publicity in such things—especially where the work in question is to be carried out on public undertakings and at the public expense.

Municipal Wiring and Contracting.

YEAR by year the municipal councils have come forward with their applications to Parliament for electric wiring and contracting powers. As individual boroughs they have had defeats, and so they have cuddled under the motherly wing of the L.C.C. This mother bird cackled well last year, but that was all that came of it. It is beginning to cackle once again. It has laid an egg called the "General Powers Bill," whose constituent parts include clauses No. 63 and 64; but the Electrical Contractors' Association is determined to give the old hen an uncomfortable time in the hope of rendering the hatching process a failure. We have so often used arguments against this form of municipal electrical trading as being quite opposed to the best interests of the electrical contracting trade, and also being outside the legitimate scope of municipal enterprise, that we need hardly repeat them here. The Electrical Contractors' Association last Friday night discussed the matter in some detail, after hearing what Mr. R. Tweedy Smith, its honorary solicitor, had to say regarding it, and the upshot was the passing of a resolution pledging it to prevent, by every legitimate means, the passing of the objectionable clauses. The Council of the Association is to try to obtain an interview with the President of the Board of Trade in order to voice the feeling of the industry, and if we correctly judge the attitude of the Government and people at the present time regarding the limitation of municipal trading in competition with ratepaying businesses, the clauses should be defeated again this year, and more decisively than in 1903. At all events, for the good of the industry, that is our hope.

FISCALITIS: A CONVERSATION.

Reported by A. LE STRANGE.

"Hello, here comes Tariffe!" exclaimed Freeth, looking up from his "chop and fried." "He'll be brim full of Chamberlain's last speech. See how he's looking round for me, so that he can fire off some of the ready-made Protectionist arguments he found in his *Gramophone Record* this morning."

"Oh, look here!" I exclaimed, as I saw Tariffe had caught sight of us, and was making for our table; "if you fellows are going to upset my digestion by talking Fiscalitis all through lunch, I shall ask the waitress to move my plate to a quiet corner."

"No, don't go away, old chap. Think of Katie's feelings, if you have no respect for mine."

"Katie," I said, calling our favourite waitress, "if these two"—Tariffe had joined us by this time—"if these two say a word about Protection or Free Trade, call the manager and have them pitched out for creating a disturbance."

But Katie only sniggered, and took Tariffe's order.

"Well," commenced Tariffe, with the self-satisfied smile of one who has backed a winner, "you have read Chamberlain's speech, of course; what do you think of it?"

"I am exceedingly obliged to Chamberlain," replied Freeth, very seriously. "The country owes him a deep debt of gratitude. His energy is simply marvellous, and I only hope he will be able to keep up a little longer."

This was a somewhat surprising speech, and, as I raised my eyes, I could see that Tariffe was as doubtful of its genuineness as I was.

Freeth was rather given to sarcasm at times, but just now he looked as serious as a judge.

"Yes," he continued, "Chamberlain has absolutely converted me."

"Shake, old man, shake!" said Tariffe, as he excitedly extended his hand across the table, knocking over the cruet, and upsetting his glass of Lowenbrau over his Filet de Sole Frascati.

"You don't quite understand me," quietly added Freeth. "When this Fiscal boom first started, I was a Free Trader by birth, so to speak; now, owing to the evangelising influence of the 'Missionary of the Empire,' I am a Free Trader by conviction."

"Don't talk rot, nothing could be more convincing than Chamberlain's arguments. Aren't our markets open to the world, and the markets of all protected countries practically closed to us? Call that Free Trade? Why, it's trying to fight a man with both your hands tied behind you. Both in our own and all neutral markets the foreigner can beat us, because, having his own protected market, where he can get his own price, he can 'dump' his goods into this and other countries and undersell us."

"Yes," assented Freeth, "that's just what Chamberlain said in one of his early speeches. You have got it nearly off by heart, old man. At Greenock, you will remember, he told the meeting 'the steel trade is going,' that the American Steel Trust produced 20,000,000 tons of steel per annum, and that 10,000,000 tons of it would soon be 'dumped' in this country."

"Well, surely, you don't intend to argue that that is a good thing for this country," put in Tariffe.

"I certainly was rather startled," continued Freeth, "but, you see, I rather believed in J. C.'s accuracy at that time. My confidence was a bit shaken when I read a day or two later that the *whole* output of steel of the United States was under 18,000,000 tons, of which the Steel Trust turned out only 9,700,000. They wouldn't have much left for themselves after dumping 10,000,000 tons, would they? 'Only a figure of speech' did you say? Well, we always forgive a dog his first bite, but he gets shot or poisoned the second time. And besides, we can't create iron out of clay you know. What price our engineering, bridge making, ship building, and tin plate industries if we can't get cheap iron? It's good business to import cheap iron, 'dumped' iron if you like, and export manufactured goods—which means the employment of labour, isn't it? I call it a very good business deal. What's that—we don't export manufactures to Protected countries? But don't we, though. Just examine the returns for the last 12 years or so, and you will find that our exports of manufactures to Germany have increased over 24 per cent., to Russia 47 per cent., to the self-governing Colonies 42 per cent., and to unprotected countries only 12 per cent. And, as to the iron industry being on its last legs, you will find that between 1893 and 1902 the gross profits assessed for income-tax on our iron works rose from £2,000,000 to £6,000,000.

"Beg pardon—not Chamberlain's figures? Oh dear no, those are not Mr. Chamberlain's figures, they are facts."

"'Pon my word, you talk like a bally encyclopædia," said Tariffe, seizing an opportunity to get a word in, whilst Freeth took a well-earned drink. "But what about America? You were careful not to quote any statistics as to our exports to that country, and they don't take much from us in return. They jolly well keep us out with their high tariffs, and as they have a free market over there, they are building up enormous manufacturing industries at the expense of our working men."

Freeth, smiling and like a giant refreshed, went for his man again.

"Now tell me a single industry which America has injured. Tell me even a single line of goods which they have held in this country? Their complaint is that as soon as they get a foothold over here in any special line, they gradually lose it. Take boots, machine tools, electrical tramway accessories, motors, anything you like, and what is the invariable history? They do well for a time, then British manufacturers, noting the creation of a new demand, rise to the occasion, remodel their designs on British-American lines and reap where America has sown. Instead of injuring, America in the long run stimulates our manufacturing industries.

"'What about dumping,' did you say? I'm coming to that if you will only give me a chance. You are nearly as bad as the 'vulgar dog' who interrupted Chamberlain with 'What about sugar?' But he 'wasn't taking any.' He could not allow the thread of his argument to be interrupted with any such trivial detail as sugar.

"Now 'dumping' means that the foreign manufacturer, say the American and the German, by having his own and our markets open to him, can produce in very large quantities, and therefore very cheaply: that is the 'quantity argument.' He obtains a fair—or more than fair—price in his own country, and sells his surplus over here at cost, or below cost, price. Is that it?"

"Yes," assented Tariffe, "that's about it; and it's simply ruining the electrical industry in this country. Do you know that as a result of American and German competition the prices of motors are about 25 per cent. less than they were two years ago?"

"I admit the prices, but not the cause," said Freeth, opening a small note book. "Listen to this. 'The estimated value of electrical and auxiliary manufactures in the United States for the year 1904'"—reading from the note book—"'was £48,000,000, of which exports altogether amounted to about £2,250,000,' less than 5 per cent. 'Britain's share of the exports,'—now listen to this—'amounted to £230,000.' Have you absorbed that? Well, now suppose America had exported nothing at all, her electrical manufactures would have been almost £46,000,000 instead of £48,000,000, and the little bit we took makes a difference of a quarter of a million in 48 millions. Where does the 'quantity' argument come in? *A surplus production of half of 1 per cent., a paltry quarter of a million is building up the American electrical industry and ruining the British, in which there is a capital of about £40,000,000 invested!* Man, you ought to be ashamed of yourself. Even Chamberlain—and he has made some terrible mistakes since he started his campaign—knew better than to talk about the electrical industry when he went to Preston. Why, the exports of the Preston works of Dick, Kerr & Co. alone would not be far short of the whole of the American exports to this country. 'What about Germany?'—I'm coming to Germany, if you'll only have a little patience. I wanted to convince you first that America does not benefit at all by the 'quantity' argument, so far as her electrical exports to this or any other country are concerned. Watches? For goodness' sake, give Mr. Byng's watches a rest—you'll over-

wind them if you aren't careful, and then they won't go at all. You said 'Germany,' first, and it's Germany you are going to have, or nothing."

I was getting about sick of this, so told Freeth if he intended to start afresh on Germany, I was off.

"Oh, don't go, Le Strange, old man," Freeth pleaded. "I shan't take a minute about Germany. I have let Tariffe have it all his own way with me up till now, but the worm has turned. Look here, I'll stand you a cup of coffee, and blow the expense, if you'll stay." Having called for three coffees, he proceeded:

"After all, what do our electrical imports from Germany amount to? A measly £120,000! Think of it; £120,000 worth of 'dumped' German goods ruining an English manufacturing industry in which £40,000,000 are invested! And even that trifling amount is falling off. 'Better trade in Germany?' Yes, I know. I have your authority in my pocket here," producing the current copy of *Electrical Investments*, and reading: "It is to be remembered, however, that the improvement in the condition of the electrical industry in Germany made the desire for export orders at all costs much less urgent."

"I am surprised at a Free Trader like you reading such a staunch Protectionist paper," said Tariffe, mockingly. "Keep it up, my boy, and we shall see you brought into the fold yet. It has been the means of Fiscal salvation to blacker sheep than you."

"Thanks all the same, but I don't read *Electrical Investments* for its opinions, but as a literary tonic. Now, what is the meaning of the paragraph I just read to you? It means that the rise of German exports is a sign of bad trade in that country, and a fall is a sign of returning prosperity. What an admission from a Protectionist paper! Why, it absolutely gives the whole Protectionist case away. Exports, they have always argued, are an index to industrial prosperity, not depression; but the returns for 1903 and 1904 have rather spoilt that argument. And it was not a question of 'export orders at all costs,' either. The best German manufacturers are getting better prices for motors over here than in Berlin."

"Nonsense!" retorted Tariffe; "I've heard that lie before. No, no, Freeth; I didn't mean anything personal. You have heard it, and so have I; but, honestly now, you don't believe it, do you?"

"But I do. I've got the actual figures here of all sizes, as given me by Sonhammer, the London manager for the British-Schneider Co. For a motor whose rock bottom price in England is £33, the *ordinary* price in Berlin is under £30 10s., and the others are in about the same proportion; and, mind you, that is not the lowest price in Germany, but the price they try to get.

"Of course, there are cheap German motors just as there are cheap English ones, but from the estimates I have seen lately for both continuous and three-phase, the up-to-date leading English manufacturers can undersell the best German firms.

"When Mr. Chamberlain first started his evangelising tour," continued Freeth, "he was simply bristling with statistics—generally inaccurate, by the way—but he won't look at them now. All the trades he said were on the brink of ruin, and could only be saved by a mild dose of Protection, seem to have had an uncommonly good year. Iron, coal, tinplate, straw-plaiting, cotton,"—

"Hold on," interrupted Tariffe, "what about cotton? Mr. Chamberlain gave some awkward figures for you at Preston in connection with the number of people employed in the cotton trade, and he showed that Protected countries were doing more work than we were during the late hard times."

"Yes, the figures were awkward," sneered Freeth, "awkward for Chamberlain, because they were inaccurate, as usual."

"Oh, come now," protested Tariffe, "don't make general statements of that sort. Play the game."

"All right, old chap, keep your wool on; there's nothing to get annoyed about. You are not Chamberlain, you know. Besides, Chamberlain ought to be glad that all his Protectionist arguments have been falsified. He says he is a Free Trader, you know, so does Balfour, so does Jesse Collings."

"That is not the point," persisted Tariffe, "you are raising side issues because you can't substantiate your accusation about incorrect figures. Chamberlain quoted from the Census records to show that 19,000 fewer people were employed in the cotton trade in 1901 than were employed 10 years before. And he asked how it was that during the time cotton was so high and the Lancashire mills were working short time, the protected countries were doing better?"

"Yes, and some 'vulgar dog' gave him 'a flat contradiction.' Now, have you taken the trouble to look up the facts for yourself?"

"No," replied Tariffe. "Chamberlain's word is good enough for me."

"Well, I should be very sorry to shatter your idol, but here are the true figures for 1902, 1903 and 1904. In 1902 and 1903 we took about 40 per cent., and in 1904 about 46½ per cent. of the whole of the raw cotton exported by America. So that while we took last year about 6½ per cent. more than the average of the two preceding years, the rest of the world took 6½ per cent. less, a relative increase of 13 per cent. to us. These figures refer only to the first 11 months, as the December figures are not yet published. The figures for last November show that we took from America 47½ per cent. of her exports to the world, or nearly half. It does not fit in well with your Protectionist argument that protected countries, having our free market, manufacture in larger quantities, does it? Even America, with her 'free' cotton, only exports about £9,000,000 of finished cotton goods, against our export of £84,000,000 last year. And in spite of the Dingley Tariff, America imports £10,000,000 of cotton goods, against our £5,000,000."

"Oh, look here, Freeth, you are getting off the track altogether," protested Tariffe, and not without some reason, for Freeth was rattling off figures as fast as he could get them out, with the aid of a little memorandum book. "What about the number of people employed? that's what we started from."

"Well," replied Freeth, nothing daunted, "Chamberlain was right about the numbers."

"It's some satisfaction to hear you admit so much."

"But," continued Freeth, "if you were a Lancastrian—which you are not—you would know what 'piecers' and 'half-timers' mean. At one time a very large number of youngsters, called 'half-timers,' were employed in the mills. They went to school half-days, and to the mills the other half. Now, whilst Chamberlain was perfectly correct in saying that 19,000 fewer persons were employed in 1901 than at the previous census 10 years before, he did not explain—and I give him credit for not knowing—that there had been a *decrease of 40,000* among the children and young persons employed, but an *increase of 20,000 adults*. That sounds very different, doesn't it? But look here, it's your innings now; you have been cross-examining me all the time. Let me ask you a question: If Protection does not raise prices to the consumer, what about sugar?"

"Sugar!" exclaimed Tariffe; "that isn't Protection at all."

"What!" gasped Freeth, "not Protection—a tax which, combined with prohibition, has doubled the price of sugar, putting £7,000,000 a year on to the price, that has ruined a large number of manufacturers, that has thrown over 20,000 people out of work, to say nothing of the indirect effects, and all for the sake of putting a quarter of a million into the pockets of the West Indian planters. Not Protection, indeed! Then Heaven help us when we do get the genuine article!"

When I left them, they were still arguing, trying, if I remember rightly, to find the Colonial offer.

Thames Conservancy and Electric Lighting Orders.—At the meeting of the Thames Conservancy Board on Monday last, letters were read from Messrs. Wyatt & Co., the Parliamentary Agents, stating that in the case of the Woolwich Electric Lighting Provisional Order and the Brentford Electric Lighting Provisional Order (Brentford Electric Supply Co.), the clauses asked for by the Conservators for the protection of their interests had been agreed to.

INSTITUTION OF ELECTRICAL ENGINEERS.

"EARTHING."

By W. W. Lackie.

(*Abstract of Paper read at Glasgow, on Tuesday, February 14th, 1905.*)

The subjects of earthing and bonding have been prominently brought before the electric light and power contractors of this city, owing to the fact that the electricity department of the Glasgow Corporation, has for the past six years consistently refused to connect installations in which a metal sheathing is used as a protection to the wiring and as a means of carrying or supporting the conductors, unless it is earthed at one point at least and electrically connected throughout its entire length.

Gas pipes should not be used as earth connections, as frequently the current which flows to earth when a conductor gets in contact with an earth is sufficient to melt a soft metal pipe; and further, the method of jointing a branch gas pipe of iron to a main gas pipe often does not make a good contact between the branch and main, the branch pipe being, in some cases, insulated by brown paper and white lead. A water pipe is almost universally used for an earth connection.

The rule referring to earthing and bonding, in the general rules recommended for wiring for the supply of electrical energy, issued by this Institution, is badly worded, inasmuch as that anyone might assume from it that conductors conveying currents at pressures of 250 volts and under, need not have the tubing efficiently connected to earth, and that such tubing or sheathing need not be electrically continuous throughout its length, whereas it is a matter of prime necessity that all sheathing should be electrically continuous throughout, and it is just as necessary that it should be earthed and electrically continuous at 100 volts as at 250 volts or over.

The rules issued by the Glasgow Corporation specify that all metal-sheathed cables and metal tubes or conduits must be perfectly bonded at all joints and effectively connected together and to earth, by means of an insulated stranded copper conductor. The earth connection must not be to a soil pipe, rhone, or gas pipe, but to a water supply pipe. This is a most important rule, particularly in buildings where there is a gas supply in compo piping. All electric conductors must be kept away from gas pipes and most carefully insulated from them by a spacing not less than 1 in. in thickness, no matter what system of wiring be adopted.

All fittings must be substantially insulated from any adjacent metal pipes, joists, columns, &c., so as to avoid contact with them, which might break down the insulation of the lampholders. Fittings exposed to the weather or fixed in damp places must have the lampholders efficiently insulated from them.

The reason for these regulations is, of course, that the middle wire of the three wire system in Glasgow, as in other places, is earthed under normal conditions at one of the generating stations, and the fact that should a cable in a consumer's premises, connected to the positive or negative main of the three-wire system, get in contact with the metal sheathing, the latter immediately becomes part of the conductor, and any one standing on a metal or concrete floor, or in contact with anything earthed, and touching the sheathing, not connected to earth, would get an unpleasant shock, which might cause, and has caused, death. It could also easily happen that if the sheathing was not earthed and electrically continuous, one length of sheathing might come into contact with the positive conductor, and another length with a negative conductor, in large buildings where both sides of the Corporation three-wire system are in use, with the result that there would be 250 or 500 volts difference of pressure between two adjacent lengths of piping. An arc would, of course, soon result, which might ignite any inflammable material.

During the years 1902, 1903 and 1904, 35 fires were reported to the electricity department of the Glasgow Corporation by the fire department, as having been due to defective electric light installations. Two of these were, in the opinion of the electricity department, not due to electricity at all. Of the remaining 33, 15 were due to the melting of gas pipes by a current of electricity, the installation in each case having been carried out with metal sheathed cables; eight of the fires occurred on installations where the metal piping or metallic sheathing of the cables was not properly earthed; seven were on installations where the iron piping or metal sheathing was earthed. The remainder were caused by the cables having been chafed by contact with the sharp edges of iron pipe ends; by a piece of hot carbon falling from an arc lamp; by defective twin flexible conductors; by defects in switches; by wooden casing saturated with water; and in a wood casing installation, by the conductors making contact with a soft gas pipe.

The effect of these fires was much more serious in the 15 cases where soft gas pipes were melted.

Considering only the first 15 cases, and especially the seven where the metal sheathing was earthed, the fact of current going *vid* the gas pipes at all, shows one of two things, viz., either that the current flowing to earth and back to the generating station divides up between the one, two, or more paths to earth in proportion to the conductivity of these different paths; or that by increasing the earth connections the current going to earth is increased by the increased conductivity to earth of the earth circuits.

It is impossible to test an installation after it is completed, with a view to ascertaining whether the metal sheathing is in itself properly electrically continuous throughout its entire length, and whether the continuity of earthing throughout is not due to the sheathing being earthed at one point by the earth wire run for that purpose, and at another point by means of a gas pipe or other pipe. It may be that for part of the course a gas or water pipe is the connecting link between two lengths of sheathing.

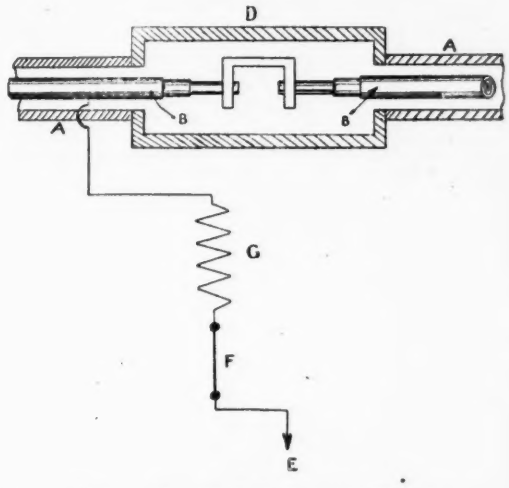
With the present system of earthing, if one conductor, even in a small branch circuit, comes in contact with the sheathing, the current that flows momentarily, but long enough to blow both branch and main fuses, is frequently 250 to 300 amperes, and is sufficient not only to cut off the whole supply from the installation on which the fault has occurred, but to interfere with the supply to other consumers by causing an unpleasant blink in the light. A momentary short circuit has been reported on several occasions to the mains section of the electricity department of this city, by the generating section of the same department, as having taken place in such and such a district, and it has afterwards been found that these short circuits were due to an earth on a three-ampere branch circuit in a consumer's premises. Bearing these facts in mind, the author has come to the conclusion that the present method of earthing at any point and direct is wrong, and it is his opinion—

1. That the metal sheathing on installations for connection to public supply mains should be kept clear of all other metal work throughout the entire run of the conductors;

2. That the connection to earth should be through a resistance of such an amount as would allow of not more than, say, two or three times the normal current of the installation flowing to earth in the event of one of the conductors coming in contact with the sheathing; and

3. That the metal sheathing on installations for connection to public supply mains should be joined to earth at one point only.

It will readily be seen that if the sheathing used for carrying electric lighting and power conductors were insulated throughout its entire length, even if it were only by ¼ in. of wood, cheap rubber or fibre, it would be possible to test, after any installation was completed, and to see that the cable sheathing was clear of all other metal work in the building, and also that it was in itself electrically continuous. These considerations are most important.



Howard Conduit Co.'s Earthing System.

If a resistance were in the earth circuit, the rush of current would be reduced enormously, and would probably result in only a small branch fuse melting, the main fuse remaining intact—*i.e.*, where the fault or earth occurred in a branch circuit. It would be even a better arrangement if each set of branch pipes had a proportionate resistance inserted to a separate slightly insulated earth wire, and the sheathing of the mains had also a resistance.

One good reason for earthing the metallic sheathing covering electric conductors is, of course, the prevention of possible dangerous shock to the public, and the insertion of a resistance of the size suggested would not militate against this in any way.

Several stations have adopted this course to protect their works from a complete shut-down. To ensure continuity of supply the middle wire of the three-wire system is earthed through a resistance of a tenth of an ohm, or in some cases one ohm.

The method of earthing the middle wire in the Port Dundas electricity works in this city, is as follows:—In circuit with the usual recording ammeter there are ten 200-c.p. 250-volt lamps connected in parallel, which are, however, short circuited by a fuse. Should an earth connection come on the positive or negative conductor, so that more than 50 or 60 amperes is made to flow back to or out from the generating station, the fuse short-circuiting these lamps goes and the lamps light up. When this state of affairs takes place (let it be said it is not a normal state) the difference of potential between earth and the positive and negative poles is far from being 250 volts. If an earth of very low resistance comes on the negative, the positive will be 500 volts and the middle conductor 250 volts above earth, and if the fault be on the positive side, the negative will be 500 volts below earth and the middle 250 volts below earth.

The idea of introducing a resistance, to the extent suggested, on the earth circuit, is probably novel, so far as the wiring is concerned, but to introduce a resistance of some kind is not new in

underground main works, as the Howard Conduit Co., Trafford Park, Manchester, in a descriptive pamphlet of their asphalt conduits for underground mains, advocate this. This asphalt pipe is made with a spiral of iron wire surrounded throughout the entire length of the spiral with ½ in. or ¾ in. of asphalt. The company state that one of the objects of their system is to provide a safeguard against stoppage of supply when the insulation of a cable breaks down.

The method of connecting up their pipe is shown in the accompanying diagram. D represents an asphalt-lined joint-box protecting the connection between two lengths of lead-covered cable, B, laid in the asphalt pipe, A, the lead of the cable being insulated from the joint-box by the asphalt, and the lead covering of the cable is connected to earth at E through a resistance, G, of 1 ohm, and indicating fuse, F, to blow at 25 amperes. The lead of the cable is divided up into sections at the joint-boxes. The only path from the lead covering to earth is through the resistance G and the fuse F. In an ordinary case, if a failure of the insulation of the cable occurs, causing a short circuit to the lead, and so to earth, the cable is burnt out, or the circuit-breakers are opened and the supply interrupted, causing considerable trouble. In this system of laying, the fuse F, in the section in which the fault occurs, is blown, and the lead covering is then insulated from earth by the asphalt troughing. The position of the fault is easily located by an inspection of the fuses in the various street boxes, without the necessity of making tests or interrupting the supply. The cable can still be utilised until a convenient time comes for repairing the fault. It is also claimed that this resistance reduces electrolytic currents.

If in circuit with, or if the earthing resistance on a consumer's premises took the form of an electro-magnet, which would close a secondary circuit so as to ring a bell, sound an alarm of some kind, or light a tell-tale lamp, each installation would become self-testing. The winding of the resistance in the form of an electro-magnet would also, in cases of dead earths, act momentarily as a choking coil. A fuse of a certain capacity affords no protection against leakage current, which is, as a rule, leakage to or from earth, so long as that current does not exceed that at which the fuse will blow. The above arrangement would act before the fuse, and even a simple electro-magnet in circuit with the earth wire without the resistance advocated would be an advance on present practice. It has frequently happened that, for some reason or other, the fuse on the branch main connected to the neutral wire on an installation connected to one side of a three-wire system has gone, and the installation has had an earth connection on the same conductor (*i.e.*, the neutral) inside the premises beyond the fuse. The installation still continues to have a satisfactory supply through this earth connection and the earth connection at the generating station. Such a state of affairs goes on until a time when the positive or negative conductor goes to earth somewhere else, when either the lamps dim down very much or brighten up and probably burst. If a resistance of the amount suggested was inserted in the earth connection, the chances are that the consumer would very soon see that something was amiss, due to the bad pressure brought about by the supply having to come or go by the earth resistance; and, moreover, if a bell or other device were connected, as indicated, with the resistance, it would immediately show that current was passing by the earth circuit.

The reason for earthing at one point is obvious if a resistance is to be inserted in the earth connection. For testing purposes it would be convenient to disconnect the earth connection. If earthed at more than one point, several resistances would be required, so that the joint parallel resistance should equal a resistance such that only two or, say, three times the normal current would flow to earth; but further current is diverted over the other metal work of the building if earthed at several points. But even if a resistance is not inserted, the fall of potential when an earth current flows is, to a great extent, on the consumer's premises—*i.e.*, it is between the point on the sheathing at which the fault occurs and the earth, and it is not between the generating station and the consumer's premises, nor between the consumer's earth connection and the generating station. If several paths are given between the metal sheathing and earth on different floors of a building, there is, as before, current diverted over all the other metal work of the building, and such stray current may cause arcing sufficient to melt pipes—gas and water—and, if gas, fire will result.

The resistance of the earth part of the circuit may be exceptionally low in Glasgow. If in other cities or towns, or in places where isolated plants are laid down, the resistance of the earth part of the circuits is high, or where earth plates are used, and not the water or other service pipes, the earth circuit may form the resistance now advocated. In Glasgow, between the generating station at Port Dundas and Waterloo Street, a distance direct of 1,000 yards, the earth resistance is approximately ·05 of an ohm.

On a private installation the maximum power possible through an earth or short circuit is the power of the plant, but with a fault on a consumer's premises in Glasgow there may be the power of the whole electricity works at the back of the fault for the time being.

In installations carried out with lead-covered conductors, the core being stranded, many faults have occurred due to a strand breaking and making contact with the lead. The contact made has been so good and the current so great for the instant that the lead has been burned clean off from the point of the broken strand, and the fuse protecting the circuit has in some places gone and in other cases stood. When it has gone the lead has been melted clear of the strand; testing shows nothing; and the fuse can be replaced. The installation may seem all right again, but sooner or later trouble will be experienced with a conductor in this state. What has just been said might be used as an argument in favour of solid wires up to No. 14 in place of small wires stranded for lead-covered cables, seeing that the lead covering makes the cable rigid, irrespective of what the copper core is. With a resistance in circuit with the lead sheathing to earth, the author feels that the current should not be so great as to melt away the lead at the point of contact with a broken strand of a small cable. If by accident a plumber or other tradesman does come along and runs an earth connection across the metal sheathing, the installation will be no worse than it is at present, and testing would show this if the sheathing is supposed to be clear of other earths. The comparatively enormous damage generally done to a small motor when one of the conductors in it goes to earth, in the opinion of the author, justifies putting in a resistance on the earthing wire to limit the current. There are already many metallic sheathed installations in Glasgow connected to the Corporation electricity mains which only require the resistance in the earth wire to put them in line with what is advocated in this paper. The sheathing has been kept clear of all other metal work in the buildings in which they are contained, by means of a strip of wood run throughout the installation for the purpose of cleating the pipes or cables to, and has been earthed at one point in the basement. A resistance of about 3 ohms for a 25-ampere installation, to carry 70 to 90 amperes, will not cost more than 30s., and for a 100-ampere installation £2. The resistance need only be one to carry the maximum current for, say, half a minute.

By insulating the sheathing throughout its run, earthing it at one point only, and introducing a proper sized resistance on the earth circuit, we have—

1. Made it possible to make a further and important test at all times, even after an installation has been completed;
2. Increased the efficiency of the supply;
3. Reduced the already small risk of fire from electrical causes;
4. In no way interfered with the precautions for the safety of the public from shock;
5. Rendered installations continuously self-testing.

The reason for insisting that fittings and lampholders, or lampholders alone, should be insulated is given in Rule 43 of the Corporation rules in the words, "which might break down the insulation of the lampholder." Another and even more important reason is that if the lampholders were not insulated, they would most assuredly break down the insulation of the lamp caps in use. Cases are on record where the insulation between the lamp collar and one of the terminals is *nil*. All lamp caps on 250-volt lamps will stand 250 volts between the two terminals, but few will stand 250 volts between one of the contacts and the metal collar on metal-collared lamps, or the lampholder on porcelain or vitrite-capped lamps. Besides, it will have been noticed that in the abnormal state of division of pressure between the positive, neutral, and negative conductors and earth—*i.e.*, when the positive or negative main is to earth—it is quite possible that between one lamp contact and earth, if the holders are earthed, there will be at times a difference of pressure of 500 volts. The lamps in general use to-day are not meant for this, and, consequently, the simplest and the cheapest way is to insulate the lampholders, and remove these two dangers.

CONDENSING ARRANGEMENTS IN CENTRAL STATIONS.

On the 19th ult., before the Leeds Local Section, Mr. J. D. Bailie read an exhaustive paper on the subject named above. Beginning with ejector condensers, the author passes on to jet and barometric condensers, touches on the counter-current principle, and proceeds to evaporative and surface condensers. Air and circulating pumps are also dealt with. The author states that the prevalent belief that there is difficulty in maintaining high vacua is quite erroneous; his recipe appears to be the use of common-sense in selecting the type of condenser, and arranging and erecting the plant, so that the popular idea is at least excusable! A vacuum of 28 in. of mercury is easily obtained on full load, he says, and by means of the Parsons vacuum augmentor, vacua within 0·33 in. of the barometric column have been obtained.

The author discusses the amount of cooling water required, and the quality of the water, pointing out that too often the latter is ignored until much money has been wasted upon plant of unsuitable type. He gives an instance of a cooling tower in a Sheffield steel works, where the water absorbed so much deleterious matter from the atmosphere that it rapidly corroded the tubes of the surface condenser!

Briefly referring to cooling ponds and towers, the author passes on to the exhaust steam piping, and shows that a serious loss of vacuum may be incurred through valves of insufficient area. Great attention must be given to the jointing and drainage of the exhaust pipes and valves. Automatic valves should be tried every day. Remarks on suction and discharge pipes, &c., bring the paper to a conclusion. Numerous illustrations are given, but are on too small a scale for reproduction.

In an appendix the author gives particulars of a number of tests of condensers, with explanatory remarks.

FUEL ECONOMY IN STEAM POWER PLANTS.

Discussion on January 26th and February 9th.

Col. Crompton, in opening the discussion, expressed the opinion that electrical engineers did not realise their deficiencies in respect of matters of combustion. He eulogised Mr. Booth's excellent work in this connection, from which he had personally benefited. The paper offered valuable opportunities for criticism, and on one or two points he disagreed with the authors. The latter were quite

right in their views on furnace construction—water-tube boilers particularly had suffered from mistakes in setting. There was a prevalent idea that it was impossible to prevent smoke without introducing excess of air; but he thought refractory furnace linings had solved the question. He referred to power plant in Calcutta, where bad Bengal coal was used under water-tube boilers; the authors' suggestions as to furnace construction had been followed, and smokeless combustion had resulted. He believed that thermal storage would be of the greatest advantage at times of peak load, although the resulting economies could not altogether be explained, some 200 per cent. extra work being obtained from a boiler when only 25 was expected. Thermal storage had in practice reduced the coal consumption at one generating station from 4 lb. to 2·9 lb. per unit. He thought Mr. Booth still hankered after the Lancashire boiler, although he was now agreed that the water-tube boiler offered exceptional facilities for combustion. The travelling grate possessed marked advantages when dealing with varying fuels and percentages of ash, far more so than the enclosed grate. He believed that the steam engine would keep up with the internal combustion engine if engineers would employ high enough temperatures. Referring to superheat, it not only dried the steam, but had enormous advantages in preventing leakage past sliding surfaces, and, furthermore, he contended that it was not responsible for cut surfaces as sometimes suggested.

Mr. H. L P. Boot referred to his grease separators at Tunbridge Wells station, where he used his botwell water directly in the boiler, losing, however, 5 per cent. of the volume. He further mentioned an arrangement he had adopted for boiler feeding, the feed water being led into trays suspended in the steam space of the boiler, where it was heated up to boiler temperature, and also deposited impurities. He commended the idea of providing an air lining to boilers and deprecated the idea of a works staff conducting experiments on flue gases &c. He considered the Lancashire boiler of great value in the central station for steady work; the water-tube boiler was useful on account of its rapid steaming properties, when used in conjunction with the former type. He had found that the removal of the mid-feather for the purpose of fixing a superheater in the downtake at the rear of a boiler led to difficulties. Cheap fuel in his opinion was not economical if heavy railway rates had to be paid on it. In his experience, with plant using steam superheated 150° F., he had not obtained more than 18 per cent. saving in comparison with ordinary saturated steam.

A representative of Messrs. Crosfields, of Warrington, confirmed the authors' views in regard to the treatment of feed water. The Mersey water required daily analysis owing to its great variations in hardness. A little oil in the feed water was not objectionable, providing the water was alkaline. In his opinion 13 per cent. of carbonic acid was a suitable proportion for flue gases, but not more, except with hot air furnaces. He agreed with the authors' remarks on fuel testing, and described a system of superheating employed with the Lancashire boilers in his firm's works, where the flue gases were passed over the boiler tops, in specially arranged flues, *en route* to the chimney, resulting in a gain of some 7 per cent. superheat

Mr. Druitt Halpin's remarks were, unfortunately, inaudible to the majority of the members; we gathered, however, that he was in agreement with the authors in their suggestions as to the treatment of feed water, elimination of oil, &c., but could not understand their statements in regard to the use of zinc in boilers. He demonstrated that heat transmission through boiler plates increased in greater proportion than the increase of temperature, and supported the authors' contention in regard to the use of cheap fuel in preference to dear, as also their remarks on radiation from steam pipes and air leakage through the grates of mechanical stokers, but he considered that the trough arrangement described by the authors for preventing air leakage through chain grate stokers would be very difficult to work satisfactorily. The controllable superheater was a very good thing, but he was afraid that the complication of the joints was an objection, as also the possible depositing of lime in the pipes, if the water were not properly purified. He was in agreement with the authors in regard to steam production, but it appeared to him that much higher furnace temperatures were possible than those given by the authors on page 25.

Mr. J. H. Rosenthal opposed Col. Crompton's "dismal views" as to the central station engineer's knowledge of combustion matters. He considered that the results obtained with thermal storage at the Kensington station only proved what would seem theoretically possible. Turning to the paper, trained men, in his opinion, were not necessary for fuel, water or gas analysis; neither was there such a lack of knowledge of furnace design as the authors seemed to suggest, judging from the results obtained He declared positively that mechanical stoking was the only cure for smoke, judging from his 25 years' experience, for no furnace design would cure smoke with smoky fuel. He considered that more trouble was experienced from excess of air with hand firing than with mechanical stokers; the latter were now provided with devices which ensured the production of from 10 to 12 per cent. of CO_2. He could not agree that there was no thermo-dynamic gain in superheat; the minimum saving of fuel at Hamostead since they introduced the superheater was 10 per cent. He concluded by expressing the hope that no one would be misled by the erroneous impressions given by the authors.

Mr. H. N. Holland, apparently through some misunderstanding, attacked the authors' position in regard to the use of batteries. He opposed the suggestion that expert manipulation was necessary for flue gas analysis, &c. With regard to the authors' suggestions on the use of express boilers, they required special firing, and ordinary water-tube boilers were sufficient for ordinary work. Air leakage through the brick setting of water-tube boilers, he attributed to the great heat produced, also to inefficient methods of fixing ironwork, &c. His company built up the fire-brick lining separate from the outer brickwork; the lining did not last so long, but was far easier to repair. He offered the suggestion that a second brickwork shell round the boiler, giving an efficient air insulation, would be an improvement. With regard to chain grates, he had found them absolutely smokeless, and his company only found it necessary to clean them once a week. The Roney stoker, which he took it was the inclined grate shown by the authors, directly contradicted their rules for setting, and he mentioned that the Mersey Railway Co., who used that stoker, were constantly being prosecuted for smoke nuisance He agreed with the authors' remarks on the Ados recorder, he used it regularly, and found it was conducive to economical working; they usually obtained 12 to 14 per cent. of CO_2. He found that the recorder needed weekly checking.

Mr. Leon Gaster suggested that the authors had neglected the advantages of liquid fuel, and offered to communicate further remarks.

Mr. W. M. Mordey, referring to heat radiation losses, stated that he had found the radiation loss on a transformer case at a temperature of 40° F. was equal to 1 watt per 3 sq. in., or some 420 units per year per square foot.

Mr. W. H. Molesworth commented on the fact that the authors did not refer to the use of pulverised coal; in certain tests which he had carried out there was a marked gain in efficiency. Owing to lack of time he asked to be allowed to communicate further particulars of the results obtained.

Mr. W. C. Thomson expressed the opinion that it was impossible to prevent smoke when starting up or taking off large banks of boilers, notwithstanding the use of chain grate stokers.

Mr Ruthven Murray thought the authors had not given power station engineers credit for what they had done; it must be remembered that engineers could not afford to experiment when putting down new plant. Referring to the use of glazed brick casing for boilers, he stated that it cost 12 per cent. more than ordinary brickwork, but it largely prevented leakage, and gave good heat insulation. The outside temperature of the glazed brick casing was 140° F. in certain boilers with which he was connected. He agreed with other speakers that chain grate stokers in actual practice did not prevent smoke.

Mr. W. H. Booth, replying to the discussion, refuted the idea that he was opposed to the water-tube boiler. Some 20 years ago, when the Babcock & Wilcox boiler was introduced into this country, it was largely composed of cast-iron, while English engineers were agreed on the necessity of using mild steel for boiler-construction work. Water-tube boilers rarely had furnaces which would burn bituminous fuel, but now he felt justified in considering that the water-tube boiler had, in fact, come round to his ideas. It was satisfactorily constructed, and provided with much improved furnaces. In regard to mechanical stokers, he had had some seven years more experience than Mr. Rosenthal, and did not hesitate to affirm that they were not a smoke preventative. Mr. Holland had criticised the inclined grate illustrated in the paper. It, however, was not the Roney stoker, as suggested, but was a good design for such apparatus; this, however, did not affect the furnace construction shown in conjunction with it. Further, in reply to Mr. Holland, he pointed out that he had not deprecated the use of batteries, as they had great possibilities, and that leaky stop valves were not necessary for cylinder warming—a bye-pass valve would do it much better. With regard to superheating, the controllable superheater gave a much more steady temperature, and a higher mean temperature; the water control practically damped out the extreme and dangerously high fluctuations of temperature.

DISCRIMINATING RELAYS AND CUT-OUTS: A FURTHER REJOINDER.

By M. B. FIELD.

I read Mr. Andrews's reply to my recent article on "Discriminating Cut-outs and Relays" with great interest, and have to thank him for the trouble he has taken, and the courtesy he has shown, in replying to the various points in my paper.

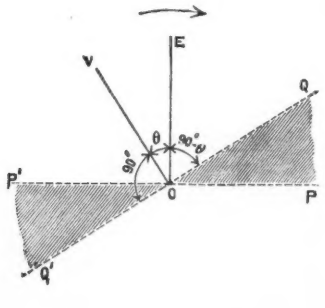
The experiments Mr. Andrews describes are very interesting as experiments, but I cannot consider them in any way as a refutation of my argument. Partly in view of the vague and undefined sense in which Mr. Andrews uses the phrase "reverse-current," and also in order to avoid all possibility of my being misunderstood, I very carefully explained in my article the exact sense in which I employed the terms "forward" and "reverse" current, and I must still adhere to my statement that no amount of *forward*-current should operate a discriminating relay.

Mr. Andrews, in the last paragraph of his "reply," heartily endorses this recommendation, although, curiously enough, the whole of the previous matter is in contradiction thereto. When reading the last paragraph, I was so surprised and puzzled, that I was compelled to re-read the statements preceding that paragraph to see if I could possibly have construed them in the "reverse" direction.

Take the experiments Mr. Andrews mentioned, where he broke the field circuit of an alternator with the engine stop-valve open. He states that his cut-out operated, and that the wattmeters rotated in a *forward* direction, showing that there was a *forward* current, and yet he entirely endorses my opinion that a discriminating relay or cut-out should be so constructed that it will not be operated "by any amount of forward current." In the circumstances cited, a wattmeter relay certainly would not operate, and, indeed, should not. Why should it? The mere occurrence of a combination of circumstances, constituting a semi-dangerous or undesirable condition, is not sufficient ground *per se* for a so-called reverse-current relay to operate. This semi-dangerous condition must also be accompanied by reverse current before the relay will act. There are a hundred and one possible combinations which constitute dangerous conditions where we do not expect a reverse-relay to act, and do not attempt to make it do so. I should no more expect a discriminating relay to operate under the conditions Mr. Andrews describes, than I should expect it to take care of a short-circuit on the bus-bars.

In writing my article, I had no intention of a deliberate onslaught on Mr. Andrews's cut-outs, but the challenge involved in his reply compels me to state some points intentionally omitted in my article.

In Mr. Andrews's relay, under discussion, the shunt current is thrown back through an angle θ behind the supply E.M.F. of the circuit, and the designer recommends the



value 45° for this angle. In the accompanying clock diagram, O V represents the current in the shunt coil of the cut-out, O E the supply E.M.F. A current, therefore, which leads the supply E.M.F. O E by less than $90 - \theta$ degrees, or lags by less than $90 + \theta$, has a component in the same direction as O V, and any current lying between these limits will not operate the cut-out. A current leading by more than $90 - \theta$, or lagging by more than $90 + \theta$, will have a component in the opposite direction to O V, and will actuate or tend to actuate the cut-out.

We have then a current lying between the limits O P and O Q that will operate the cut-out, but this is a forward current with respect to the supply E.M.F. O E. We further have current lying between the limits O P′ and O Q′ that will not operate the cut-out. This, again, is a reverse-current with respect to the supply E.M.F. O E. These two conditions are diametrically opposite to those which admittedly should determine the action. In the first case we have a discriminating relay which will open circuit if a generator supplying power in parallel with others be sufficiently under-excited to cause it to work with a forward leading current of ·7 power factor,* or less, and in the second place, will not open the circuit if the generator be over excited and the steam to the engine be partly or wholly cut off so that the generator is receiving a motoring current of power factor ·7 or less. This is what I referred to in my article when I stated that the introduction of the spurious phase difference θ was undesirable. I am afraid the confession of relays of such morality would be:—"We have left undone those things which we ought to have done; and we have done those things which we ought not to have done; and there is no health in us."

Mr. Andrews will perhaps ask how I would deal with the case he mentions. To this I reply that, not the relay, but the switchboard attendant should deal with it, because, as indicated in the footnote, an exactly parallel case may arise of the generator supplying forward leading current *without the field failing*, when it would be undesirable to open the circuit.

The machine with a failing field is at once detectable by the readings of the field ammeter. The excess current flowing (50 per cent. in the case in question) is, in general, not dangerous. Idle current ammeters connected to the machines will also be found to give most valuable information in similar cases.

As a general rule, however, if two machines be running in parallel at full load and the excitation of one be cut off, it will run out of step, the governor will cut off steam, reverse power will flow, and the wattmeter relay, if properly constructed, will operate. If the machine does not run out of step there is no reason, as far as I can see, why it should be immediately cut out of circuit. Possibly the failure of the field circuit may be due to a cause which may be immediately remedied, but if this is not so, the switchboard attendant can deal with the emergency as above explained. In the course of my experience I have seen, on more than one occasion, the field switch of a loaded generator opened by mistake, and, as the generator did not run out of step—simply closed again. In those instances it certainly was fortunate that no Andrews cut-out was in circuit to immediately interrupt the supply of the temporarily failing generator.

Mr. Andrews tells us, further, that many years ago he started off with the idea that a reverse power relay was all that was necessary, but that the result of the intervening years' close study of the matter has forced upon him the conviction that "something more" is wanted. Mr. Andrews considers that he has now filled the gap of this something more by means of the spurious phase displacement which makes the cut-out operate with a forward leading current of ·7 power factor, or less. One would almost think that Mr. Andrews considers he has, as the result of several years' work, invented a unique mechanism to perform functions which are peculiar to it and incapable of imitation by any other device. What he has done is:—

1. To give up the delicate relay for the less delicate cut-out.
2. To introduce the phase difference.

Now, it is evidently just as easy to introduce this phase difference, if required, into the wattmeter relay, as in any other device, and hence I fail to see the justification of Mr. Andrews's condemnation of the wattmeter relay. As a matter of fact, by the introduction of a phase difference, the Ferranti relay can be made to perform precisely the same functions as those claimed by Mr. Andrews; *but*, the Ferranti relay would then have all the disadvantages possessed by the Andrews cut-out, with the single exception of the want of delicacy. After all, to end the discussion, let us suppose that the question whether the relay should operate with a leading forward current at all is a matter of opinion. In this respect it is most comforting to me to have Mr. Andrews's assurance that my opinions are not only in concert with those of all novices; but also with those of American and Continental designers of experience. Mr. Andrews's position in the matter is, I confess, somewhat mystifying, for, while endorsing my opinion that the relay should not work with forward-current, he strongly advocates his cut-out because it does do so. The only explanation I can offer is, that Mr. Andrews would define "forward" and "reverse-current" in another way to that which appears to me to be the only possible way, and which I stated as clearly as possible in my article; and also that he had not sufficiently appreciated this definition before endorsing my opinion. If so, we are, of course, arguing at cross purposes, and further discussion is idle until each appreciates the fundamental definitions of the other.

* Adopting Mr. Andrews's recommendation to adjust the value of θ to about 45°, it is only necessary to manipulate the excitation of the generator, so that it is supplying power with a leading current of power factor ·7 or less, to cause the current to lie within that region throughout which the cut-out is more or less operative, according to the delicacy of the mechanism, the region being that between O P and O Q in the diagram.

Imports of Foreign Telegraph Cables.—The value of the foreign telegraph cables and apparatus imported into this country during January last amounted to £5,913, as contrasted with £6,464 in the preceding month, and £3,749 in January, 1904.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Arithmetic Absurdities and other Things.

I notice the following passage in the *Pall Mall Gazette* of the 11th inst. under the heading of "Arithmetic Absurdities" :—

"Sir Oliver Lodge is soundly anxious that multiplication should no longer be synonymous with vexation, that the rule of three should puzzle children less, and that practice should no longer drive them mad. The terms of arithmetic at present in use, he says, are 'the worst things ever concocted by a nation emerging from semi-barbarism,' and make of the science 'the most absurd of the complexities of pretended commerce.' It is undoubtedly the case that arithmetic is made much more repulsive and difficult than it need be by its cast-iron jargon, and that any amount of children's time and brain labour is wasted that might be saved by more rational methods. But there is one most appalling waste of time that all of us have undergone, and that it does not lie in the power of teachers to save unaided. We mean the awful complexities of 'compound' sums and reduction in England. On the happy Continent, where decimal coinage and weights and measures prevail, all sums are 'simple,' and there is nothing but a little ticking off of centimes from francs, for instance, to be done. Here the five-and-a-half-yards-one-rod-pole-or-perch, the 1,760-yards-one-mile, the impossibilities of square measure, and the confusion confounded of avoirdupois, apothecaries', and Troy cost a needless slice from every child's lifetime."

What is the objection to the terms of arithmetic at present in use? Why do they deserve such sweeping condemnation? Is there more "cast-iron jargon" about arithmetic than about grammar? Technical terms cannot be altogether dispensed with in the study of any science. Most arithmetical terms are words in common use (*e.g.*, sum, difference, product, measure, &c.), and should, therefore, be more easily understood by children than the technical terms of most other sciences, which require a knowledge of Latin and Greek roots before they can be properly understood. Perhaps this is why so few teachers of arithmetic seem to think it necessary to teach children to give accurate definitions of the terms they are constantly using. In other subjects, geography, grammar, &c., whenever a new term is introduced, its meaning is explained and its definition learnt by the pupils, and the learning of these definitions forms an important item in the study of the subject. Yet in arithmetic, where accuracy and clearness of thought are most essential, this elementary step is almost entirely neglected. It is quite true that "any amount of children's time and brain labour is wasted that might be saved by more rational methods," but this is due, not to the terminology of arithmetic, but to the fact that rule-of-thumb methods of teaching are used instead of rational methods.

In the introduction to the "Science and Art of Arithmetic," by Sonnenschein & Nesbitt, we are told that "the aim of the authors is to lead the student to the discovery of the several rules by some path such as an original discoverer might have travelled." How many teachers of arithmetic base their teaching on this principle? With regard to the "awful complexities of compound sums and reduction in England," I should like to ask what need there is to inflict the barbarities enumerated upon children in the elementary stages of arithmetic? There is little difficulty about money sums, and the sums dealing with weights and measures should be confined to the weights and measures in daily and general use. Why should a child of nine or ten be worried with tables only required in certain trades and professions? Square measure and cubic measure belong properly to the study of mensuration, and should not be entered upon until that stage is reached. It is utterly irrational to expect children to multiply and divide by such quantities as $5\frac{1}{2}$ or $30\frac{1}{4}$ before the study of fractions has been even entered upon. Each fresh step should follow naturally and logically from what has gone before, and its *modus operandi* should be elicited from the pupils through their previous knowledge.

Another rule which involves a most deplorable waste of time and brain work is practice—more especially compound practice. The name was probably bestowed upon it on the *lucus a non lucendo* principle, for it is difficult to imagine time being wasted upon it in the counting-house. In many class-books it is introduced before vulgar fractions, notwithstanding the fact that it is based on the use of the aliquot parts of various units, and that in most compound practice sums (unless they have been carefully prepared with a view to the avoidance of such inconveniences) we get troublesome fractions of a penny, which become more and more intricate with each successive step in the working. In one class-book in fairly general use, and in which both practice and proportion precede vulgar fractions and decimals, the following suggestion for overcoming this difficulty is put forward in all seriousness :—

"When, in examples like the following, fractions occur in the partial values, they may be reduced to decimals correct to two or three places, and the last decimal place in the answer rejected." This is followed by a model sum, in which the awkward remainders are expressed as decimals of a farthing! The child that could follow these directions without a knowledge of decimals would indeed be an infant prodigy.

But why should such stumbling blocks be deliberately placed in the path of the children? What need is there for them to attempt at this stage to solve commercial problems that cannot be worked by the rules they have learnt? Such problems belong to a much later stage, and by the time that stage is reached, it is to be hoped that some better method than compound practice will suggest itself for dealing with them.

In a report submitted by a Government inspector some years ago, we read :—"The progress made in arithmetic is out of proportion small in comparison with the extraordinary labour bestowed upon it, a result which I attribute less to the intrinsic difficulty of the subject than to the manner of teaching it."

The blame does not rest entirely with the teachers in this matter. They, as well as the children, would be only too glad to be relieved of the burdens imposed upon them, but, as long as such absurdities find a place in text-books and in examination papers, teachers must make an effort to help the children to grapple with them.

The time wasted in this manner might be utilised to far better purpose in going through each section of arithmetic (integers, vulgar fractions and decimals) twice instead of once, the first time dealing only with general principles and simple applications, and the second with fuller details, improved methods and more extended applications, these applications, however, being strictly limited to what can fairly be included in the section in hand.

In the same issue of the *P.M.G.*, Sir Oliver is reported to have expressed the opinion "that in teaching music very little progress would be made by restricting a pupil to scales and exercises. The pupil should be taken to concerts as early as possible."

Is Sir Oliver Lodge so great an authority on music as he is, for instance, on wireless telegraphy? I believe he, and most of his fellow professors, look upon the Charlottenburg Reichsanstalt as *the* example we in England should follow if the Old Country wishes to be in the forefront of science. At all events, the Reichsanstalt was much quoted at the dinner of the Junior Institution of Engineers last Saturday. In Berlin, the Academy of Music over which Dr. Joachim presides, is said to be all for technique; and how does Sir Oliver think the embryo pupils who, at an early age, are taken to concerts to listen to all that is best in the Divine Art are ever to play what they hear if scales and exercises are not so rigorously enforced during their pupilage as to ensure perfect technique?

Can we not improve upon our musical education, as well as upon our scientific methods, by taking a lesson from Germany?

T. E. G.

Life Insurance for Engineers.

I have lately made inquiries about insuring myself for a small amount against accidents. Three risks are given;

ordinary, medium, and hazardous, but on making application under the last named, I was informed that I came, as a mechanical and electrical engineer, under a fourth class, called the extra-hazardous risks, and should have to pay about double the amount of the ordinary risks.

I am an engineer-in-charge at a large generating station, an abstainer, and have never had any serious illness. I should be glad to know what terms other fellows in the same position as myself insure on?

E. N.

Private Mains Across a Street.

I am in charge of an isolated plant, and we have other premises across the street, which we should like to have lit from our plant. Can we carry our cables overhead across the street? If so, at what height from the street level? Are there any restrictions contained in the electricity supply Bill of our corporation to prevent us from carrying our cables across to our other premises?

Nemo.

[This is an oft-recurring question, and one of very general interest. "Nemo" is perfectly at liberty to carry mains across the street, to supply not only his own premises, but also those of any other person who is willing to take a supply from him. The only conditions are:—That he complies with the Board of Trade regulations as to mode of suspension, &c.; and that he obtains the necessary wayleaves from private owners whose property is crossed by the overhead mains. The Corporation cannot interfere with him or with his cables, unless it happens to come under the second condition named above—that is, unless it owns the *freehold* of the roadway. The cables must not be less than 30 ft. from the street level (in London, 35 ft.). Nothing in the Corporation Electric Lighting Act can affect "Nemo."—Eds. E.R.]

Water-cooled Rheostat.

I have read with much interest the letter of Messrs. H. Lea & Sons in the Electrical Review of January 6th, 1905, concerning directly water-cooled resistance wires, and as I have had some experience in this line, I beg to make some remarks upon this subject.

As to the directly water-cooled resistances, I know from my own experience that they have been used for many years by one of the greatest electrical concerns in Germany as a cheap and effective means to load dynamos on their trial tests, and the dimensions of the iron wires in relation to the current check fairly well with the values found by Messrs. H. Lea & Sons. The observed discrepancy between the "theoretical current" and the actual one is due to the heating of the iron wire, which effects a rapid increase of the resistance. It is obvious that there must be a considerable drop of temperature between the wire and the water in order to force so great an amount of heat units through the small surface of the wire into the cooling liquid. In the cases referred to by Messrs. H. Lea and Sons, the rise in temperature of the wire above the temperature of the water is about 380°, total 450° F. I take occasion to remark that it is quite erroneous to figure resistance wires, &c., upon a certain current density, unless a sliding scale is used, as the radiation and convection of heat depends from physical reasons upon the surface of the wire. It is well known that resistance tapes are able to carry more current with the same rise in temperature than wires with circular cross-section, both supposed to have the same cross-sectional area. From the three tests, the following "cooling surfaces per KW." have been calculated:—6·8 sq. in. per KW., 8·0 sq. in. per KW., 10·1 sq. in. per KW., corresponding with the current densities 25,300 amperes per sq. in., 176,000 amperes per sq. in., and 56,000 amperes per sq. in. For pressures up to 500 volts, and not too much mineralised water, the leakage current through the water, and therefore the electrolytic effect upon the wires, is not very great, provided that the arrangement of the resistances does not encourage these stray currents, but above this voltage much difficulty may be encountered. However, I remember a case where the leakage currents were so great, although the pressure was comparatively low, that the wires were completely deteriorated after a few hours' run. For transportable testing resistances a more substantial arrangement has been made by winding the resistance wires on porcelain cylinders, immersed in a watertank. By arranging the cylinders in parallel connection, the load can easily be adjusted. The cooling surface of these cylinders is about 6 sq. in. per KW., a value which checks with the average of the corresponding values, calculated from the three tests referred to by Messrs. H. Lea & Sons.

Fred. E. Meurer.

San Francisco, Cal.
January 29th, 1905.

Discriminating Relays and Cut-outs.

I have been interested in the recent correspondence relating to discriminating relays and cut-outs, and note that there appears to be an apparent want of logic in Mr. Leonard Andrews's comment on the Bristol test.

In the test referred to—that is, on a generator with a failing field, and steam supply maintained—Mr. Andrews states that the governor was unaffected, from which it would be inferred that *full steam* admission was maintained. In any event, power was delivered by the faulty generator. This fact is borne out by the fact that the wattmeter in the Bristol test revolved in the same direction as when the generator was acting normally. From this it is conclusive that the current delivered from the faulty machine was not a leading current of 90°, as explained by Mr. Andrews in his paper recently read before the Institution of Electrical Engineers (Manchester Section), which condition his relay had been specially designed to meet. He would appear to have considered the unpractical condition of generators operating in parallel with no external load, and running in perfect synchronism. Mr. Andrews apparently fails to appreciate the condition of affairs which exists when two alternators are run in parallel, one excited normally, while the field winding of the other is open-circuited, but has its field produced by the magnetising effect of the armature currrent supplied from the normally excited machine. It is quite possible to operate two machines in this manner, provided they have a fairly high armature reaction. In fact, two identical machines having sufficient margin in field ampere-turns may be operated under the above conditions at full terminal voltage, and cope with an external load.

Thus it is evident that, if Mr. Andrews's relay were used in connection with generators of large armature reaction, and under certain conditions of external load, it would prove inoperative when the generator field failed.

In conclusion, it might be mentioned that Mr. Andrews's discriminating relay is really a phase indicator, but an inaccurate one, and very restricted in its operation. It would appear to be far more satisfactory to adhere to an *accurate* form of wattmeter relay, and, if necessary, provide a separate direct-current device to deal with the question of failing fields, than to adopt an inaccurate form of phase indicator which possesses the doubtful advantage of dealing with the question of a generator with a failing field under *given* conditions as to armature reaction and external load.

H. Pierson.

Manchester, *February 13th*, 1905.

To Charge Engineers.

The interesting discussion on the relative merits and status of the engineers-in-charge at electric light stations having closed, I would ask your kind permission to allow me to draw the attention of all such engineers to the "Association of Engineers-in-charge," who hold their meetings at the St. Bride Foundation Institute, Bride Lane, E.C.

The membership roll contains the names of engineers-in-charge of hospitals, asylums, hotels, workhouses, infirmaries, saw mills, public baths, waterworks, factories, breweries, soap works, &c., and also a few electric light stations.

The papers that are read at the Association meetings cover a wide field, and are, as far as possible, thoroughly practical, and when printed, they remain valuable for reference. The Association makes the reading and discussion of

papers its chief aim, for the members realise that unless they progress with the times they will be left behind in the engineering world, and no man worthy of being called an "Engineer-in-charge" can afford to reduce his chance of success. Visits are made to various works of interest, so that each can note and realise the immense strides the engineering community is making in every direction.

Every endeavour is made to bring the members together to talk over their difficulties and so assist each other.

The governors of the St. Bride Foundation Institute allow the members the privileges attached to membership of the Institute, thus enabling them to meet at any time within the building for educational or social purposes.

There must be some hundreds of engineers-in-charge at the electric light and power stations scattered throughout the United Kingdom.

Who amongst them will form themselves into a deputation to meet the Council of the "Association of Engineers-in-charge," so that some agreement may be arrived at whereby all qualified men can have the pleasure of combining with their fellow engineers-in-charge to mutual advantage?

You, sirs, have assisted the "Association of Engineers-in-charge" in many ways in time past. May I ask for your kind interest in furtherance of the object I have in view?

Arthur Davey.

London, *February 11th*, 1905.

[We have pleasure in inserting this letter.—Eds. E.R.]

Electric Winding Gear in Collieries.

I hear from a correspondent abroad that a colliery in Wales has recently installed an electrical winding gear for a deep shaft. Perhaps one of your readers could kindly tell me whether this is true, and where the colliery is situated.

W. O. Rooper.

Westminster, S.W., *February 7th*, 1905.

A Correction.

In your last issue, in your description of the electrical installations of the Natal Government Railways, South Africa, we note you state that the contract for the station equipment was placed with Messrs. Davey, Paxman & Co., of Colchester.

We beg herewith to make a slight correction. The contract for the boilers and boiler house equipment was placed with Messrs. Davey, Paxman & Co., but the contract for the whole of the station equipment, comprising engines, generators, switchboard, piping, condensing and cooling plant, was placed with our firm.

Bruce Peebles & Co., Ltd.

Roland S. Portheim, *Managing Director.*

[We regret the error, which it was not in our power to prevent.—Eds. E.R.]

The First Incandescent Electric Lamp?

I have a lamp in my possession, which, I believe, is one of the first electric incandescent lamps made. The length of the lamp over-all measures 8½ in., the stem is 5½ in. long and ¾ in. diam., the bulb is 3 in. long and 2 in. diam. The platinum wire forms a loop at the end of the stem for external contact and passes through fine glass tubes to the bulb, and is then lapped round the filament.

Could you, or any reader, give me any information as to the date and maker of the first lamp made?

A. W. Reed.

Shrewsbury, *February 12th*, 1905.

Arc Lighting in the City.

With reference to the "flame" arc lamps put up in the vicinity of the Mansion House, respecting which a notice recently appeared in the technical papers, it has no doubt escaped the notice of the City lighting authorities that the arc lamps which have been fitted up are of German manufacture. In view of the present state of trade, it seems rather peculiar that the premier city of the Empire should have to go abroad for arc lamps to light its streets, when there are in this country numbers of manufacturers of *high-class arc lamps*, both "flame" and otherwise, who would be only too pleased to submit most satisfactory lamps for practical test on the streets, more particularly because, in this case, if the trials prove satisfactory, no doubt a very large number of the lamps will be required.

Thanking you in advance for the insertion of this letter as a matter of public interest—

Observer.

One-sided Specifications.

Enclosed I beg to hand you extracts from specifications for the electric lighting of a church.

You will observe that the powers demanded by the consulting engineer are absolute. There is nothing he may not do or leave undone. I think it a great pity that consulting engineers should be allowed to issue such specifications, and it is very much to be deplored that contractors are to be found who will enter into contracts with such specifications, having absolutely no means of redress in the event of any dispute arising.

In my opinion, it is high time the Institution of Electrical Engineers proceeded to draw up some regulations or suggestions which would control the actions of some of their members.

Fair Play.

[The extracts above-mentioned certainly endow the consulting engineer with absolute dictatorial powers, and are not in harmony with the model conditions which the Institution has already drawn up.—Eds. E.R.]

Electrolytic Rectifiers.

I have read with interest about the tests conducted by Mr. Horace Boot on a Nodon rectifier, but there is one point which seems contrary to my experience with electrolytic rectifiers of various types, namely, the statement that, provided the aluminium plates are lifted out of the solution when the current is switched off, there is no heavy rush of current when the rectifier is switched into circuit again. Now, in my experience, which I may say has been a very extensive one, unless a resistance is placed in circuit with the valve on the alternating current side, there is always a rush of current on starting, and this necessity forms one of the great disadvantages of such electrolytic rectifiers, at least in those cases when the apparatus is entrusted to the charge of a man ignorant of electrical matters.

It has been shown, theoretically and practically, that although the thin coating of aluminium hydroxide which is "formed" on the anodes may be perfect, this, by itself, does not prevent the rush of current when starting the valve, but that the "sealing" property of such rectifiers depends to a large extent upon the formation of a gaseous sheath, which of course disappears every time the plates are withdrawn from the solution.

In a properly constructed aluminium cell it should be possible to leave the anodes permanently in the electrolyte, whether the current be "on" or off, and this condition becomes of first importance when using such aluminium cells as condensers for resonance or capacity work, an application which may assume some magnitude in the near future.

A. W. Isenthal.

I read, with a great deal of interest, Mr. Boot's account of the tests he made on the "Nodon" rectifier. I should like to know if Mr. Boot thinks it would be any advantage to insert a coil of negligible resistance and high self-induction in series with the direct-current circuit.

Such a coil would greatly smooth out the current curve, by reducing the maximum value without affecting the root mean square value. Thus, I suppose, a larger charging current could be used without injuring the cells. By designing the coil with a variable air-gap, the coefficient of self-induction could be kept fairly high through a large

variation of load, so that the same coil could be used for cells requiring widely different rates of charge.

Perhaps some of your readers can tell me whether anyone has used an oscillograph to ascertain the quantity of electricity which is required per square foot of lead surface to form the film of phosphate of aluminium and zinc. It appears as if the cells which are being charged would have to furnish a small reverse current (sufficient to form this insulating film) every time the alternating E.M.F. passed through its zero position.

Further, up to what pressure is it possible to work such a rectifier with single cells, and is it possible to work above that pressure by replacing each cell by two or more in series?

The reply of the E.P.S. Co. to Mr. Boot's query is especially interesting, as previously it was commonly accepted that the effect of a charging current which varied periodically between zero and a maximum was to disintegrate the plates.

W. F. Wolfe.

Preston, *February 13th*, 1905.

Homopolar Dynamos.

Your abstract of the paper read by Mr. J. E. Noeggerath, before the American Institute of Electrical Engineers on January 27th, cannot fail to be of great interest to designers of dynamo-electric machinery.

The General Electric Co. is to be congratulated upon trying such an experiment on a commercial scale. Since the advent of the steam turbine, the thoughts of many designers of direct-current dynamos have, no doubt, been turned to the possibility of constructing an up-to-date Faraday disk dynamo.

The writer, having been called upon some two years ago to design some homopolars for electro-chemical work, worked out many designs, amongst which was a type of machine identical with that which has now been brought forward by Mr. Noeggerath.

One design which was worked through, was for a 500-KW. machine, turbine-driven at 1,500 r.p.m., having 12 conductors on the armature, each generating 19 volts with a flux of 76×10^6 lines, and of a section sufficient to carry 2,200 amperes. These were connected to slip-rings on each side of the cast-steel armature, the output thus being 228 volts and 2,200 amperes. By doubling the speed, which would be quite possible with the 30-in. diameter armature employed, the voltage would be doubled, and the output raised to 1,000 KW.

Several methods were proposed for the collection of the current from the slip-rings, but practical experiment was necessary to determine which of these was the best.

The whole problem is, of course, the collection of large currents from slip-rings running at high surface speeds, as the slip-rings *must* be large in diameter, as the return flux must go *through* the rings.

The difficulties in designing homopolars diminish in proportion to the size, *i.e.*, if there were a demand for very large direct-current generators of 5,000 to 20,000 KW., homopolars would clear commutating dynamos out of the market.

Single conductors would suffice, and the difficulties in current collection would be greatly reduced, but, of course, in these days of high voltage polyphase distribution to rotaries, such a demand does not exist. There is no reason, however, why motor-generators with homopolars on the direct current side should not come into use in the near future.

The practical difficulties which Mr. Noeggerath has encountered and successfully overcome, such as the reaction of the currents flowing in the slip-rings, could only be dealt with after an experiment such as this.

A fallacy which was current until recently was that this type of dynamo had an inherently large pressure drop owing to armature reaction, and one finds this repeated by many writers on the subject; but in all the latest homopolars which have been constructed, such as that of Brown (see "Dynamo-Electric Machinery," latest edition—S. P. Thompson), the regulation has been exceedingly good—in fact, it need not exceed the CR drop of the armature and brush contacts. The great mechanical simplicity and small labour costs on this type of dynamo are certainly very strong points in its favour. It may be repeated, the *collection* of current is the whole problem, and there is a vast field for research in this direction.

Fielder J. Hiss, Jun.

London, N., *February 14th*, 1905.

Disposal of Scrap Carbon.—A correspondent wishes to know the name of a firm that would be prepared to engage for the disposal of scrap carbon, of which he holds a very large stock.

LEGAL.

Phillips *v.* Kingston, Miller & Co.

(*Concluded from page* 217.)

On Wednesday, 8th inst., Mr. Thomas Barratt was examined, and said he was working on the job for Mr. Simmons at the time of the accident. He was an electrician's assistant. After the tester came and the wires were connected, the lights were going for about an hour on and off. When Mr. Simmons came in the lights were going. After Mrs. Phillips had gone the lights were switched off, and the three fans were still running. Witness had occasion to call Waites. After he got half way down the room he smelt something smouldering, and called out to Waites to switch the fans off, and then he saw the smoke coming out of the fan. He saw a black patch, and ran up the ladder and tried to beat it out between his two hands. Brown came and tried to pull the muslin down. He saw some sparks. He did not notice any smell of burning rubber, but burnt rag or calico. That was about 10 minutes after Mrs. Phillips left. The black patch was at least 18 in. from the lamps.

Mr. Simmons, examined, said he was the managing director of Simmons Bros., Ltd. He went to see the work on the day of the fire. The lights were running about a quarter of an hour while he was there. At that time fire-proof muslin was not on the market.

Mr. H. Stokes, A.M.I.E.E., electrician to Messrs. Simmons, said he had had 18 years' experience in practical work. He had orders to light this temporary room for Mr. Phillips. Everything put in was new except the lamps, and the switchboard was stock. All the festoons were 5-C.P. lamps. The festoons were tested at the shop with the full voltage of 200 volts, and all wire found sound. The lampholders were made by the Sun Electrical Co. The right fuses were put on the circuit.

Mr. A. H. Dykes, A.M.I.C.E., M.I.E.E., a partner in the firm of Handcock & Dykes, consulting engineers, examined, said that the looping system came into existence before 1890. The object of that system was to have no joints. He had known the looping system used with these 5-C.P. lights. It was more expensive to use the looping system in small lamps than it was in big lamps. From his experience, if proper care was taken, there was no danger in the system used by the defendants. In nine cases out of ten the fuse would go at once if it went at all. Contact might be caused by vibration, if the wires coming out of the holder were not properly gripped, but in this case four wires had to go through the ebonite collar, and it was very unlikely that they would come out sufficiently to let the whole weight of the holder come on the wires. With a double set of wires, as in this case, the grip would be much tighter. His experience was that if a lamp was going to give trouble, it did so when the light was first turned on. In Col. Crompton's experiment, it was his impression that if the lamps had been sorted out, the circuit might have been run for days or weeks, and no more would have gone. It was possible that some of the lamps in the defendants' installation went in the shop and were replaced.

Witness considered that the arcing inside the holder would be confined long enough for the fuse to go, before anything could come out. The fuse was practically instantaneous, but there was a slight interval, which was sufficient for the fuse to go.

We have two fuses on both poles. It is suggested that you should have a fuse to every 8 or 10 lamps?—This is only a suggestion of some of the supply companies, they like you to restrict the number of lamps to 8 or 10, but merely with a view to convenience, and to ensure that the whole installation shall not fail.

Supposing you do not exceed 3 amperes, does it affect the question of how the 3 amperes is divided?—Not in the least. The fuse does not discriminate where the current is going to.

If you exceed the maximum, that is altogether a different matter?—Yes.

Is there anything improper in using this system in these small lamps?—Not with proper workmanship and ordinary care. Witness, continuing, said he had heard nothing which induced him to believe that the fire was due to the electric light.

The Judge: What, in your opinion, caused the fire?—I think probably a spark from a chimney outside.

Asked for his reasons, Witness said the first symptom of fire was noticed at a spot, a foot or two above the nearest wire. Another

circumstance was that a smell of burning was noticed some time before the scorching muslin was seen. Muslin scorched and turned black for a second or two, and there was no smoke until it burst into flame.

In cross-examination, Witness's attention was directed to the rules of the Liverpool and London and Globe Insurance Co., advising wire guards to prevent lamp bulbs from coming in contact with flimsy goods. He should not expect a workman to have any more trouble in wiring a lamp with 70 No. 40's than with 25. The rule as to fuses was only intended to apply to 8 or 16-c.p. lamps.

Cross-examined: Witness considered the arrangement as safe as if the lamps had been arranged in series, and thought vibration would hardly affect loose ends, if the caps were screwed down.

Mr. William Maurice Mordey, consulting electrical engineer, of Mordey & Dawbarn, Victoria Street, generally agreed with the last witness. The system was a proper one for a contractor to have used, and one that his firm had used by preference in work where there was a risk, such as theatre work. Nothing short of rough handling would cause contact between loose ends. In his opinion the fire could not have been caused through the electrical fittings.

Mr. Frederick Dodd, a tester for the Westminster Electric Supply Corporation, said he had tested the insulation, and found everything correct.

Cross-examined: His work was only to see that there was proper insulation, and no leakage. His company advised 8 to 10 lamps per fuse, but did not always get that. He had not tested the fans, and was told nothing about them.

His Lordship having summed up, asked the jury to say if the fire was caused by the ignition of the electric light fittings, and, if so, was it brought about by want of care on the part of the defendants.

After an absence of about 10 minutes, the jury, without answering the questions specifically, returned a verdict for the defendants on both the claim and counterclaim. Judgement was entered accordingly.

Moyse *v.* Blackwell & Co.

At the Lancaster County Court last week, Arthur Moyse, engineer, Kessingland, Suffolk, was awarded £35 compensation against Messrs. Blackwell & Co., of London, for the loss of a finger while laying the electric tramways at Lancaster, last July.

Morris *v.* Taylor.

At Bolton County Court, on February 8th, Judge J. K. Bradbury heard a case in which Frederick Charles Morris, electrician, of 7, Mawdsley Street, Bolton, sued a Manchester photographer named Taylor for the cost of an electrical installation for photographic purposes. The claim was resisted on the ground that plaintiff put in switches of 15 amperes in place of 20 amperes, and that the installation was not complete.

Plaintiff contended that there was no difference between the 15 and 20-ampere switches, that the installation was adequate, that the work was satisfactory, and that the certificate of an electrical engineer produced freed him from any further liability.

The Judge found for the defendant with costs.

Tilling *v.* Dick, Kerr & Co.

Mr. Justice Warrington, sitting as an additional judge of the King's Bench Division, on Monday, heard this action for damages caused to the plaintiff's omnibuses by the operations of the defendants, who, under contract with the London County Council, were carrying out the conversion of the tramways in South London for the purpose of electric traction.

Mr. H. Avory, K.C., and Mr. Simon, appeared for the plaintiffs; and Mr. Ruegg, K.C., and Mr. Glasgow, for the defendants.

Mr. Avory said that speaking generally, the cause of action was a public nuisance created by the defendants in laying and maintaining upon the highway, raised rails for the temporary purpose of continuing the traffic of the tramways during their operations. The defendants were clearly liable for damage caused to any individual lawfully using the highway, unless they could show express statutory authority for doing the thing which was complained of as a nuisance. Even short of that, however, it would be sufficient for him to show that they had been guilty of negligence in carrying out their statutory powers. The only authority the L.C.C. could show was one which strictly limited them to laying and maintaining the rails level with the surface of the road. So far as the facts were concerned, plaintiff's complaint came practically under two heads—first, that the defendants laid, and maintained, a temporary line, or rather lengths of temporary line, within a few feet of the kerb, raised above the surface of the roadway, so that the ordinary traffic of the road necessarily passed over it. This was done in many portions of the road where there was only a space of about 10 ft. between the existing tramline and the kerb. The second head was that, for the purpose of looping their up and down lines in some places where they did not lay a temporary line by the side of the other, they used a crossover which also involved a raised rail. There was also the allegation of negligence, consisting in putting no barrier or warning to the public at the points where raised rails had been laid. The only question before the Court was that of liability, an agreed sum having been arrived at if the defendants were liable.

His Lordship said he was prepared for that statement, in view of the fact that there were 69 separate cases of damage, some of a few shillings each.

Mr. Avory, continuing, said the temporary lines were not necessary in any sense, except for their own profit. The defendants said, as to the first 67 of the alleged accidents and the general damage shown by the fact that the average repairs to the plaintiff's 'buses during this period were much more than in previous years, that the acts complained of were done in pursuance, or execution, or intended execution of certain statutes, and the plaintiffs' cause of action was debarred by the Public Authorities' Protection Act, 1893, which sets up a six months' period of limitations within which action must be brought. As to the remaining two cases which were within the period, they paid £12 15s. into Court. Plaintiffs replied that the defendants were independent contractors, who expressly took on themselves all liability for damage and injury, and the Act did not apply to them.

Mr. Ruegg said the case involved one or two points which had never been decided before. The electrification of the tramway system was a work carried out largely for the convenience of the public, and was authorised by Parliament, and it necessarily involved a nuisance to the public—viz., considerable interference with public rights and the user of the highways. Parliament declared in 1900, that it was necessary to make most radical alterations and to carry out most extensive works over a very long distance. It was known that there would be considerable interference in one way or other with the rights of the public. There was nothing in the Act which authorised them to be guilty of negligence, and if any fault was found with the system, the responsibility belonged to the County Council, which insisted on the work being done in this way, and on the double line being kept running.

His Lordship: There is no suggestion of a better form of raised rail; but was it quite impossible to have a sunken rail?

Mr. Ruegg: You would have to interfere still more with the roadway between the tramlines and the kerb, because you would have to take it up in order to lay the sunken rail.

His Lordship: You would not lay it in the same way as a permanent track.

Mr. Ruegg said the road would have to be taken up, and that would be an unreasonable thing to suggest to a local authority or a contractor. The cross-over system, or the traffic going in both directions, would have been quite impossible in South London.

His Lordship: You say that, whereas the general Tramways Act prevents a permanent tramway from constructing lines above the surface of the road, you may construct a temporary line so that the rails are above the road if you can show that it is reasonably necessary.

Mr. Ruegg assented, and added that they did nothing more than was reasonably necessary, and were not guilty of any default or want of care. It had never until now been suggested that a contractor working for a public authority was not protected by the Act of 1893, and there were many cases where protection had been given to contractors for work imposed by statute where the public authority was liable.

His Lordship reserved judgement.

Jandus Arc Lamp and Electric Lamp Co. *v.* The Arc Lamp Co.

In the Chancery Division of the High Court on Monday, Mr. Justice Kekewich heard further evidence in this case.

Mr. Bousfield, K.C., for the defendants, said he had given to the other side a list of the experiments which had been made, and the plaintiffs had taken advantage of the invitation to see defendants' apparatus. The learned counsel further suggested if anything further was to be done, it should be done by an independent expert.

Prof. Cormack was afterwards called by Mr. Bousfield to give evidence regarding the experiments he had made with reference to the question of size of lamp and duration of carbon.

His Lordship: Is your object to show that an envelope with a large diameter will produce the same results as an envelope with a small diameter?

Mr. Bousfield: Certainly. We conceived beforehand that size had nothing to do with the matter. It was a question of leakage.

The witness thereafter gave details as to the various experiments he had made.

Having regard to your experiments, has size of globe any material effect on the life of the carbon?—I cannot see that size makes any difference at all.

How do you account for the differences?—A slight deviation in the neck of the lamp might possibly make a difference. The position of the arc and the quality of the carbons might also make a difference.

Is it possible to get uniform carbons for a series of experiments?—It can only be done by taking extraordinary care at the factory.

Leakage at the bottom of the lamp affects the light very seriously?—Yes. Leakage is the governing factor.

Cross-examined by Mr. Moulton, Witness admitted that when he tried a Beardsley lamp in the way described in the specification, the globe blackened, also in the case of Beardsley with a wide neck some of them blackened. His lamps were not intended to be exact copies of Beardsley's.

Would you explain why in all the Howard experiments you made a space round the carbons 10 times as big as is used in practice. You made it 3 mm.?—Copies were made exactly to scale from the specification, he thought the lamps he used in the experiments were fair representations of what Howard meant in his specification.

The lamps were run in series between two mains, they were commercial series lamps.

They had no shunt coils, and the consequence was that there was no way of telling how much work was thrown on one lamp, and how much on the other?—We knew exactly how much work they were doing.

Answering further questions, WITNESS said the lamps fed regularly in series, and did not require shunt coils. It was not the case that if one of the lamps shirked work, it would never pick it up again. The conditions of working the lamps were absolutely as fair as he could make them.

Prof. SILVANUS THOMPSON, who was next called, stated that he paid two visits to University College to see the experiments, and his assistant went to St. Pancras. Running the lamps in series was the best way of making the test. The lamps got precisely the same current. The experiments showed that the size of the lamps had nothing whatever to do with the life of the carbons. The effect of running the lamps in series was to make the test more valuable than if the lamps had been run separately. Diameter had nothing whatever to do with the life of the lamp. Leakage was an important factor. He had experimented with Beardsley, and found that with a narrow tube at the top, the lamp blackened. It was perfectly well known that if they enclosed a lamp too much, so that there would be no access of air, nothing could prevent blackening.

Cross-examined, WITNESS said that for some types of lamp to burn in series it was necessary to have shunt coils. Lamps were used with shunt coils which were not intended to burn in series, but to burn in parallel. There were some lamps which had a fine wire in place of a shunt. The defendants' lamps had no shunt coil and would work in series, and were sold as series lamps.

Is defendants' lamp a series lamp?—It would work well in series, and in that sense it was a series lamp.

There was no protection of any kind in connection with these experiments to make the lamps divide the energy equally?—Oh, yes. The mechanism of these lamps works with a spring, and if that spring is properly adjusted, then they work well in series.

Mr. SWINBURNE was called by the plaintiffs to give evidence concerning the defendants' experiments. Examined by Mr. FLETCHER MOULTON, witness gave evidence to the effect that series lamps must be used for series work if they desired to get any accurate results. The results of defendants' experiments did not show that any reliance could be placed upon them. Experiments which he had made proved that diameter did make a great difference in the life of the lamp.

Cross-examined, WITNESS said he thought it a very probable thing that length of arc had nothing to do with life.

Is it really your view that the mere diameter of the envelope *per se* has any material effect on the life of the carbon?—I think it has, but I don't yet understand why.

When you went to see the lamps burn you saw them in series, and you saw them burning perfectly regularly and smoothly?—The arcs were uneven. They were of slightly different lengths. I should not expect them to go wrong at the start. You must wait until they begin to feed.

Prof. ADAMS afterwards gave details as to the manner in which he checked experiments on behalf of the plaintiffs. If a man applied the Beardsley specification, he would inevitably fail to produce a marketable lamp.

On Wednesday, Prof. ADAMS, in answer to Mr. BOUSFIELD, said he had no particular reason to differ from Mr. Swinburne in that a certain amount of leakage was necessary in order to prevent the blackening of the globe.

Mr. TERRELL, in answer to his LORDSHIP, said he should have to call Mr. Swinburne to speak as to the experiments which had been made.

His LORDSHIP said that that being so, there must be another adjournment, and Mr. Bousfield had better at once prove his two experiments.

Mr. BOUSFIELD then called Prof. CORMACK, who, examined, said he had arranged the lamp the learned counsel held in his hands, and ran it for 19 hours. The blackening which was on the globe came in the course of the running. He ran it in series as the others were run. He took the voltage every quarter of an hour.

Cross-examined by Mr. TERRELL: The arc was continuously going during the time. The current varied considerably. The extreme of variation was 5·3 to 5·6. The variation in voltage was 81 to 84, as far as he could see. The bottom was sealed by means of a rubber tube; it was completely air-sealed at the bottom. In the other experiment he had four lamps in series, and the other three were blackening at the same time. There was no shunt coil on. They were all different lamps tried during the three experiments. He used about 80 volts, and 5 volts was the extreme of variation. He could not say what the extreme of variation was throughout.

At this stage the further hearing was adjourned until Monday next, in order that the plaintiffs might, in the meantime, have an opportunity of making experiments with a view to testing the evidence given on this point of the case by the defendants.

Exports of British Electrical Machinery.—The new year has opened well as regards the exports of British electrical machinery from this country, the returns for January last showing the largest total so far recorded. The shipments during the month attained a value of £72,153, which contrasts with £52,107 in December last, and only £33,726 in January, 1904.

BUSINESS NOTES.

Suction Gas Plant for Buncrana.—Messrs. James Gordon & Co., consulting engineers, of 52, Lime Street, E.C., have secured the contract for the supply, delivery and erection of the complete hydraulic and gas power plant for the electric light station at Buncrana, Ireland. The hydraulic plant consists of two of their special high-pressure horizontal shaft turbines, each to develop 60 H.P., to be directly coupled to dynamos, complete with all the necessary valves, pipes, &c., and a riveted steel pipe line about 500 ft. long for connecting to the head water. The gas power plant will be a 70-B.H.P. gas engine, complete with a suction producer plant.

Trade in Egypt.—According to the *Egyptian Gazette*, the trade of Egypt during last year made most gratifying headway, imports and exports both showing very substantial increases. May British electrical firms be well to the fore in the great work of development which has now fairly started. It will be remembered that we announced a few months ago that a number of British manufacturers, including important electrical companies, had established a big organisation to get hold of some of the spoils of industry in Egypt.

German Imports and Exports of Electrical Machinery.—There was an increase last year in the importation of foreign electrical machinery into Germany, the returns for the 11 months ending with November last showing a total of 1,310 tons, as contrasted with only 805 in the corresponding period of the preceding year. On the other hand, there was a slight decrease in the exports of German electrical machinery—from 12,276 tons in the first 11 months of 1904, to 12,164 tons in the 11 months ending with November last.

French Automobiles.—An electric traction section has just been formed in Paris in connection with the French Automobile Club. M. Krieger has been chosen as first president.

Motor Vehicles for India.—Messrs. Clarkson, Ltd., Chelmsford, have lately completed a steam delivery van, intended for loads up to 20 cwt., for the Calcutta Electric Supply Corporation, Ltd.

Nodon Patent Electric Valve.—Referring to Mr. Boot's article on the Nodon patent electric valve in our last issue, Mr. H. Snowdon, of Balfour House, Finsbury Pavement, E.C., writes to us stating that this apparatus, of which he is the sole maker, will be working at the forthcoming exhibition of the County of London Electric Supply Co., Ltd., at 118 to 122, Holborn, E.C., from March 20th to April 5th, 1905. The "valve" is made for from 50 to 140 volts A.C., and in sizes from 1 to 100 amperes, or to order.

Book Notices.—*Gas and Petroleum Engines.* Translated and adapted from the French of Henry de Graffigny, and edited by A. G. Elliott, B.Sc. Second edition, revised and enlarged. London: Whittaker & Co. 1905. Price 2s. 6d.—Seeing how much indebted we are to the French for the invention and development of the gas and oil engine, any translation of French publications must be a valuable addition to our collection of scientific literature on the internal combustion motor. The demand for a second edition is sufficient proof that the work of Henry de Graffigny has been appreciated in this country. While the price at which it is issued is low enough to enable all students, draughtsmen, &c., to avail themselves of the information collected by the author, the work is fairly comprehensive, though rather elementary. The book contains 146 pages, with 53 clear illustrations, including various classes of gas and oil motors and gas-generating plants, and a chapter is devoted to the working principles of the gas engine; later, the various cycles adopted by various makers are explained, and an additional chapter is added to this edition on "Recent Improvements," including the Diesel engine. The work is hardly up to date in regard to large power gas engines, as the largest single cylinder mentioned is said to be of 200 to 350 H.P., while the Simplex engines, with cylinders 51 in. diameter, and capable of developing 750 H.P. from poor gas, have been in use on the Continent and in this country for some time, and since 1890 many makers have turned out some really remarkable large power machines with one or more cylinders, both single and double-acting, suitable for driving electric generators, blowing-cylinders, &c.

"Tools for Engineers and Woodworkers." By Joseph Horner. London: Crosby Lockwood & Son. 9s. net.

"'N' Rays." By R. Blondlot, translated by J. Garcin. London: Longmans, Green & Co. 3s. 6d. net.

"The Record of the Special Commission of the International Fire Service Congress at Buda-Pesth, 1904." By E. O. Sachs. London: The British Fire Prevention Committee. 5s.

"Magnetisme et Electricité." By A. Nouguier. Paris: Librairie Polytechnique. Fr. 12.50.

"The Trade Barometer: The Effects of the British Wages Bill upon the Prosperity of Trade in the United Kingdom." By Arthur Lee. London: Simpkin, Marshall & Co. 2d.

"The Inventor's Adviser and Manufacturer's Handbook to Patents, Designs and Trade Marks." By Reginald Haddan. Sixth edition, 1905. London: Harrison & Sons. 5s.

"The Indian Textile Journal, Diary and Reference Book, 1905." Third edition. Bombay: The Indian Textile Journal Co. 1 rupee.

"Gas Producers for Power Purposes." By W. A. Tookey. London: Percival Marshall & Co. 1s. net.

"The Inventor's Guide to Patent Law and the New Practice." By James Roberts. London: John Murray. 2s. 6d. net.

"The Engineer's Year-book of Formulæ, Rules, Tables, Data and Memoranda in Civil, Mechanical and Electrical Engineering for 1905." By H. R. Kempe. London: Crosby Lockwood and Son. 8s.

Catalogues, Lists, &c.—Mr. G. Braulik, 217-218, Upper Thames Street, E.C., has sent us a copy of his new catalogue and price list of his "Eclipse" arc lamps. We would draw attention to the fact that these are manufactured in London. A new open type flame arc lamp is listed, together with information relating to coils, carbons, &c. We have also received a copy of Mr. Braulik's latest price list of "Eclipse" electricity meters, several types being illustrated and described.

We have received from Messrs. W. H. Bailey & Co., Ltd., Albion Works, Salford, an illustrated price list of their various types of valves. Full details and sectional drawings are given of some of these, among which we note the "full-gate" parallel slide valves for high pressure or superheated steam, blow off, scum, &c.; sluice valves for water, gas, &c.; sluice or wedge types for steam, exhaust, circulating, &c.; exhaust valves, automatic in opening and closing with outside double-acting dash pots, and Foster's patent free or automatic valves.

From Messrs. Arthur Lee & Bros., Ltd., Hayes, Middlesex, we have received a pamphlet containing a number of good illustrations and a short description of their extensive marble and slate works at Hayes. The electrical switchboard shop which contains special machinery for dealing with this class of work. Electrical power is used for operating some of the machine tools, and an electric crane of 12 tons capacity is installed. Motive power is supplied by the company's own plant, which aggregates 135 H.P.

The St. Helens Cable Co., Ltd., have sent us a nicely printed copy of their new catalogue, which has been issued especially for the benefit of those interested, either directly or indirectly, in collieries. The good qualities of the Dialite cables are dealt with at length in the introduction to the price list. This list should be of interest and value to mining engineers.

From Messrs. Balcke & Co., 27, Clement's Lane, E.C., we have received a pamphlet, just issued, giving a short description of some of their pump specialities.

Messrs. C. J. Thubsfield & Co. have just issued an abridged catalogue, a copy of which we have received, which gives some 60 illustrations of their artistic electric light fittings. The selection embodies several of the company's most recent designs.

From Messrs. Ed. Bennis & Co., Ltd., 28, Victoria Street, Westminster, and Bolton, a pamphlet has come to hand, entitled "Cheap Steam." It deals fully with their well-known mechanical stoking appliances, and details of tests are given together with tables of weights and measurements, properties of steam, combustion losses, &c.

We have received from Messrs. Royce, Ltd., Hulme, Manchester, a copy of the third and latest edition of an excellently produced pamphlet issued by this company, illustrating and describing a variety of types of electrically-driven cranes and other appliances which they have constructed and erected. A glance through this new pamphlet will show the large amount of business done by Messrs. Royce in electrical lifting machinery of all kinds, and anyone interested in such work would do well to obtain a copy.

The Salt Lake Hardware Co., Salt Lake City, Utah, have sent us a card illustrating the Keller assay balance.

To meet the requirements of those who experience a need for cheaper rubber cables, Messrs. W. T. Glover & Co., Ltd., Trafford Park, Manchester, have placed upon the market a second quality of lower price, which they recommend for such cases where moderate insulation combined with good mechanical properties suffice, and where the conditions do not require a permanent maintenance of high elasticity of the dielectric. For the production of this second or non-association quality of cables, a large addition of modern plant has been installed by Messrs. Glover to meet the increased demand which they anticipate will arise. We have received a copy of the company's new list dealing with their "association" and "non-association cables."

Bankruptcy Proceedings.—A sitting of the London Bankruptcy Court was held last week, before Mr. Registrar Giffard, for the public examination of Henry Coles, electrical engineer, late of 10, York Street, Swansea. The statement of affairs shows gross liabitities £3,727, of which £2,986 are unsecured, and expected to rank against assets £13. Under examination by Mr. G. Leadam Hough, Senior Official Receiver, the debtor stated that the receiving order was made against him last September in the Swansea County Court. Prior to 1900, he was employed as superintending engineer and electrical manager, but in that year he took premises at 2, College Buildings, Swansea, and started business on his own account. Witness only had £69 as capital, but his father had promised and rendered financial support as it was required, with the result that he was now a creditor for about £700. Asked whether the business had ever been a profitable concern, the debtor said it was difficult to give a definite reply, as some contracts turned out profitable, but others did not. In January, 1904, he removed to 10, York Street, Swansea. The business was continued there until August, 1904, when the stock and effects were seized and sold under executions and a distress for rent. Balance-sheets were prepared at regular intervals. The sheet for 1902 showed an adverse balance of £994, which, by the end of 1903, had increased to £1,592, and at the present time was £2,973. Although insolvent in February, 1903, witness decided not to stop but to convert the business into a company at a later date. It was proposed to form a company with a capital of £5,000, of which £3,000 was to be paid to witness for the goodwill, and out of that money he proposed to pay his debts. The gentlemen who were to assist him in the conversion quarrelled amongst themselves and the scheme fell through. Witness gave the household furniture to his wife in August, 1902, as a mark of love and affection. He was advised to do so because he had then embarked in business, but the furniture had now been sold and the proceeds paid away to creditors, with his wife's consent. He had drawn about £200 a year from the business for his household and personal expenditure. The debtor was questioned by Mr. Giles, on behalf of a creditor, and re-examined by his solicitor, Mr. Vant, and he was then allowed to pass.

The case of Henry Arthur White, electrician, lately trading as Ridout & Co., came before Mr. Registrar Linklater, at the London Bankruptcy Court, on Tuesday, in relation to the debtor's public examination. A statement of affairs has been filed, showing total liabilities £1,198 16s. 6d. (unsecured £1,148 14s. 10d.), and net assets £25 5s. 8d. The debtor took over Mr. Ridout's business in March, 1903, and continued it at 45, Highgate Hill, agreeing to pay £600 by instalments for the stock and goodwill. In May, 1903, he entered into a contract with the Hornsey Borough Council for installing electric light and placing ventilating fans in the Town Hall. Owing to the failure, as he alleges, of a creditor to supply materials according to specification, he was unable to complete the contract within the allotted time, and was consequently unable to obtain a balance of £110 due to him. In June, 1904, he removed the stock, which was subsequently sold for £50, which was paid away for rent. On the application of Mr. E. S. Grey, who requires further time for investigation purposes, the examination was adjourned for a fortnight. The following are the principal creditors, viz.:—

Unsecured.

Accessories Manufacturing Co.	£49	15	2
Brockie-Pell Arc Lamp, Ltd.	64	0	7
General Electric Co., Queen Victoria Street, E.C.	149	5	5
Redoubt, L.	600	0	0

Fully Secured.

London and South-Western Bank (security valued at £70)	£50	1	8

Electric Lamp Adjusters.—The London Electrical Fittings Co., Ltd., of Roberts Works, Hampstead Road, N.W., are introducing two very useful novelties for the purpose of fixing and removing incandescent lamps, which may be hot or out of ordinary reach. The patent adjuster (fig. 1) consists of a wooden stalk provided

Fig. 2.

Fig. 1.

with four projecting wire prongs, which, aided by a flexible rubber pad fixed in the end of the stalk, enable the bulb of the lamp to be gripped and turned round. One end of the stalk is provided with a socket into which a rod can be fixed, and which enables lamps at a considerable elevation to be adjusted. The above device alone is sufficient for dealing with fixed pendants; for lamps which are flexibly suspended and out of reach, the company supplies a patent rubber-covered hook (fig. 2), with which the lampholder can be held rigidly while the lamp is being attended to. The latter device is also provided with a socket for attaching to a rod of any desired length. These adjusters are inexpensive, and will greatly economise labour in large buildings, where the lamps are not conveniently accessible in the ordinary way. The above company has recently made arrangements with the Wandsworth Electrical Manufacturing Co., of Birmingham, to act as their sole agents for the London district.

Fire at Olympia.—With regard to the fire at Olympia on Friday night last, it has been stated in the daily Press that the fire was caused owing to an electric cable fusing on the stand of the United Motor Industries. Messrs. Oliver, Clark & Co. write to us saying that this was not so, as the electric lamps were fitted around the inside of a showcase, after which the attendants put in several celluloid accumulators. These, when placed near the electric lamps, at once became heated, and being of a very inflammable nature, took fire.

Trade Announcements.—Messrs. Royce, Ltd., have appointed Mr. J. G. Barber to represent them for the sale of their various specialities in the Birmingham district. Mr. Barber's telegraphic address is "Royces, Acocks Green," and his telephone number "33, Acocks Green." We understand that he has had many years' experience of electrical work generally, and is able to advise upon all matters pertaining to the electric lighting or driving of works, the installation of cranes, &c.

Mr. Robert McLaren, who has been engaged for many years in the locomotive department of the Central Argentine Railway, has now joined the firm of Topping & Seavill, engineers, Rosario, and in future the firm will trade as Topping, Seavill & McLaren, engineers, and agents in the Argentine for Messrs. J. & H. McLaren, Midland Engine Works, Leeds.

Mr. Thomas Browett asks us to state that, having accepted the position of manager of the Diesel Engine Co., Ltd., of 179, Queen Victoria Street, E.C., his offices at 6, Old Queen Street, Westminster, will be closed at the end of this month, and that all letters should be sent to him at the Diesel Engine Co.'s address.

Dissolutions and Liquidations. — Messrs. H. M. Bremner & J. Aitken (Bremner & Aitken, electric light and power engineers, Partick) have dissolved partnership. Mr. Bremner will attend to debts, &c., and will continue the business.

The first meetings of creditors and contributories in Peter Pilkington, Ltd., are to be held at Preston on February 20th.

The Electric Tramway Construction and Maintenance Co., at an extraordinary general meeting held on February 10th at 79, Queen Street, E.C., resolved upon voluntary winding up, Messrs. L. Morse and A. J. Paine being appointed liquidators.

Messrs. W. Hampson and M. W. Wickes (Liverpool Electrical Engineering Co.) have dissolved partnership.

National Engineering and Trade Lectures.—The King has been pleased to accept a copy of Mr. W. H. Maxwell's lecture on "British Progress in Municipal Engineering" just published by Messrs. Archibald Constable & Co., Ltd., and now available for reading before technical societies, Chambers of Commerce, and like institutions in all parts of the world. It will be remembered that the object of this lecture project, initiated by Mr. Ben H. Morgan, is for the promotion and expansion of British trade in Colonial and foreign markets, by means of lectures written by leading experts, and illustrated by lantern slide views, showing the progress which Great Britain has made in recent years in various industries. Copies of the lectures and sets of lantern slides will be sent free of charge on loan for reading before responsible societies in any part of the world, on application to Mr. Morgan, at Orchard House, Westminster.

Ferranti Switchgear. — Messrs. Ferranti, Ltd., have recently completed switchboards or extensions for Paisley, Wakefield, Watford, Exeter, Hornsey, Loughborough, South Metropolitan Electric Supply Co., Sydenham, Great Central Railway, Gorton, Partick, Johannesburg, Borneo, and Bloemfontein. Amongst the switchboards at present under way in their works are the following:—Portmadoc: E. H. T. three-phase 10,000—12,000 volt switchgear for main station and nine sub-stations, operating in conjunction with the Portmadoc-Carnarvon Railway, which utilises H.T. overhead transmission lines. (This, we understand, is the first installation of its kind in Great Britain.) Indian State Railways: D.C. and A.C. three-phase switchgear, to be installed for use in conjunction with the Oudh and Rohilkhand railways. Sydney: Extension to H. and L.T. D.C. and A.C. switchboards, comprising additions at main generating station, and 16 sub-station boards. Henry Tate: Two L.T. A.C. switchboards for Messrs. Henry Tate & Sons, sugar refiners, one for Liverpool and one for London works, together with a large number of distribution boards. Also switchgear for Plymouth and Handsworth.

Killarney Electric Light Works.—In the Chancery Division, before the Master of the Rolls, the matter of the Callender's Cable and Construction Co., Ltd., *v.* the Killarney Electric Lighting Co. was again before the Court to receive tenders for the sale of the estate as a going concern. The Master of the Rolls said he would accept Mr. Ryan's offer of £615. Mr. Roche, as representing some of the principal merchants in Killarney, said he hoped the present plant would be left intact.

LIGHTING AND POWER NOTES.

Australia.— Sydney. — The electrical engineer has reported to the City Council, that its borrowing powers are £250,000. Of this amount there remains roughly a balance of £20,000 available to carry out additional works. When the £250,000 has been expended, the capital cost per kilowatt of plant installed will be between £80 and £100. Melbourne, with a plant of very similar size, has spent £130 per kilowatt. In the original estimate a sale of 2,400,000 units per annum was provided for, with the machinery fully loaded. So far this estimate is confirmed by the results obtained.

Barmouth.—The B. of T. has revoked the electric lighting order of 1900.

Bedlingtonshire.—The U.D.C. has asked the Northern Counties Electricity Supply Co. to quote for a supply of energy for lighting the district.

Bedwellty.—The Board of Guardians has resolved to accept the offer of the Tredegar Coal and Iron Co, for a supply of energy to the workhouse, at 4½d. per B.T. unit.

Birkenhead.—The Tranmere Bay Development Co. has placed a contract for a gas-driven electric installation for its extensive new shipbuilding yard, now under construction on Tranmere foreshore. The gas plant is to be of 6,000-H.P. capacity, and the larger portion of the gas generated is intended for firing furnaces.

Bo'ness.—The electricity works of the burgh were opened on the 6th inst., the contractors for the work being the National Electric Construction Co., Ltd. The generating station is situated at about the centre of the town. It contains a boiler house, engine room, battery room, test room, offices and stores. The plant installed consists of two water-tube boilers supplied by Heenan & Froude, and arranged for a working pressure of 160 lbs. per sq. in., with an evaporative capacity of 7,000 lbs. of water per hour. A 96-tube Green economiser, two Weir feed-pumps, two direct-coupled, high-speed, single-acting Paxman-Lancashire Dynamo Co. steam dynamos, each of 100 KW., a balancer, motor-generators for battery charging, and milking boosters have also been put down. The switchboard is arranged for the three-wire system, provision being made for spare feeders. An 8-ton crane by Messrs. Carrick & Ritchie is installed in the engine room. The battery consists of 256 Chloride cells with a capacity of 400 ampere-hours at a 5-hour rate. The feeders are drawn into porcelain ducts with spare ways for extensions; the distributors are laid solid. All are of the British I. & H. Cables' manufacture. The total length of mains laid, including feeders and distributors, exclusive of street lighting and house services, is over 9 miles, and the number of 8 C.P. lamps ready for connection is 1,700. The principal streets will be lighted by arc and Nernst lamps, each giving respectively about 1,200 C.P. and 80 C.P., and Nernst and incandescent lamps will be used in the side streets as soon as the Council's contract with the Gas Co. expires. The total cost of the works amounts to £25,000. Collieries in the district are negotiating for a supply of energy for power purposes.

Buncrana, Derry.—A private electric lighting plant is about to be put down, comprising two 60-H.P. water turbo-generators, and a 70-H.P. gas engine, with Dowson gas plant for running the supply during the dry season.

Burslem.—The price of energy for motive power has been fixed by the T.C. at 2d. per unit, or, at the option of the Council, 10s. per quarter per B.H.P. installed, and 1½d. per unit.

Camborne.—Messrs. Edmundson's travelling electrical exhibition is, we understand, to encamp at Messrs. R. Stephens and Sons' foundry in this town some time in March. The proceeds will be given to the Miners' Hospital.

Cheltenham.—Notice has been given that the following resolution will be put at the next monthly meeting of the T.C.:—"Owing to the serious increase in the rates, largely due to the electric light undertaking, the time has come when, in the best interests of the ratepayers, (1) the cost of the staff of the department should be reduced by notice to the present chief electrical engineer of a reduction of salary by £200 per annum, (2) by the transference of the office of the department and any necessary portion of the clerical work to the borough accountant's office."

Continental Notes.—Spain.—The Alquife Mines and Railway Co. is putting down a water-power plant at Jerez del Marquesado, on the River Alcazar, to generate electricity to the extent of 300 H.P. The energy is to be transmitted a distance of five miles to the new ore-calcining works of the company, now being erected near the starting point of the Alquife-La Calahorra Railway.

Germany.—A municipal electricity works is to be erected at Kreuznach.

Belgium (Ghent).—An estimate of the cost of providing 15 electric cranes at the outer harbour has been approved by the authorities.

Devonport.—The T.C. has received from the L.G.B. sanction to borrow £7,958 for the provision of additional plant at the electricity works.

Dublin.—The L.G.B. has written to the Corporation respecting the inquiry held recently into the application to borrow £21,000 for extensions at the Pigeon House station, which is not satisfactory from the Corporation's point of view. We hope to publish details next week.

Dunfermline.—The T.C. has resolved to apply to the B. of T. for a prov. order authorising it to supply electricity within the burgh for lighting and power purposes.

Epsom.—For the quarter ended December 31st last, 23,220 units (estimated) were supplied for public lighting, 20,723 for private lighting, and 301 for power. The income for the quarter was £307 from public lighting, and from private lighting £573.

The Council recently considered a scheme for adopting electrical instead of steam pumping at the municipal waterworks. Mr. Martin Roberts, an expert appointed, showed that for the last complete year the water pumped amounted to 144,094,650 gallons; that the cost of direct steam pumping, exclusive of salaries and all capital charges, was 2·22d. per 1,000 gallons. He contrasted the cost of steam pumping with that by electricity at 1d. per unit, working out at 3d. per 1,000 gallons with a centrifugal pump, and with a reciprocating pump, 2·70d. It was further stated that energy could not be supplied at 1d. per unit. The Council decided, by a majority of one, not to adopt electrical pumping.

Gillingham (Kent).—The T.C. has adopted a free wiring scheme in connection with the electricity undertaking.

Glasgow.—On the application of the Clyde Valley Electrical Power Co., the Clyde Navigation Trustees have appointed a joint sub-Committee to reconsider the question of providing an electrical installation of their own at the Clydebank Dock.

Grantham.—An electrical exhibition, arranged by the Urban Electric Supply Co. was, we understand, to be opened in the Wharf Road Hall yesterday.

Gravesend.—The T.C. has applied to the L.G.B. for sanction to borrow £4,500 for laying mains. The Electricity Committee has circulated a statement, in which it is contended that but for litigation and other exceptional causes, the sum of £2,890, which had to be provided out of the rates to cover the deficiency on the first year's working, would have been reduced to £787, or 1½d. in the £.

The Corporation has received notices of objection to its application for the extension of the E.L. area to Northfleet, from Northfleet U.D.C., Gravesend and Milton Waterworks Co, Gravesend and Milton Gas Co., Northfleet and Greenhithe Gas Co, Associated Portland Cement Manufacturers, Ltd., South-Eastern and Chatham and Dover Railway Co., and the Gravesend and Northfleet Electric Tramways, Ltd.

Guildford.—According to a communication by Mr. H. F. Phillips, of Guildford Electrical Works, to the *Surrey Times*, it appears that the engineer to the local electric supply company requested the Corporation, when it recently considered the termination of the agreement with the gas company for lighting the town, to allow the electric supply company an opportunity to tender. This the T.C. granted, the number of public lamps, including the newly-added area, being about 617. The price quoted by the gas company was £3 7s. 6d. per lamp per annum for the existing lamps, about 400; and £3 10s. each per annum for new lamps, the extra 2s. 6d. to cover cost of mains, &c. The directors of the electric supply company, however, said that they were not in a position to undertake street lighting, and that the letter from the engineer was unauthorised by them. The gas company seeing that it had no competitor after all, revised its tender, increasing the prices to £3 10s. and £3 15s. per lamp per annum respectively. The Council is now urged to adopt a municipal electric supply scheme, in connection with a refuse destructor for which a site has already been obtained. There surely is a serious lack of business enterprise on the part of the electricity supply company, especially in view of the fact that the Council could offer a good day-load, at the Drummond Road, Stoughton Road, and Shalford pumping stations, and at the town mills.

Horsforth.—The U.D.C. has decided to take steps to ascertain the probable number of consumers of electricity, before entering into a suggested arrangement for a supply of energy in bulk, with the Yorkshire Electric Power Co.

Horsham.—The U.D.C. has applied for a loan of £4,500 for electric lighting purposes, this including £400 for free wiring.

Hove.—The T.C. has fixed the price of energy to consumers at Aldrington, at 7d. and 4d. per unit, one hour's maximum demand.

Huddersfield.—The Corporation has resolved to push the sale of energy for power purposes, and to give commission on the cost of motors, to any contractor who shall arrange for the fixing of them, and has decided to distribute a sum equal to the commission upon all motors fixed, *pro rata*, to the number arranged by each contractor, the applications for which motors have not been handed in by any contractor. The borough electrical engineer has been instructed to extend the mains to Golcar so as to supply the area defined by the Golcar E.L. Order.

The Corporation's electricity accounts for the year ended December 31st last, show a surplus of £3,875, after allowing for interest, redemption charges, and the repayment of the instalment of loan from the Public Works Board. The Committee has resolved that the surplus, together with £2,111 from the depreciation and contingency account be transferred to the borough fund, in aid of the rates for 1905-6, by way of refunding the amount received from the borough rate towards deficiencies in the revenue account for the three years 1893-4-5, amounting to £5,986. This will reduce the depreciation and contingencies fund from £11,854 to £9,743.

Ilfracombe.—The electrical exhibition recently held under the auspices of the Electric Light and Power Co. (Messrs. Edmundson's), proved very successful, the sums paid for admission amounting to £64, which was presented by the company to the local hospital.

Irvine.—At a meeting of the ratepayers, a resolution was passed objecting to the T.C. proceeding with an electric lighting scheme for the burgh.

Keighley.—The T.C. has resolved to expend £4,480 on extensions at the electricity works.

Lancashire.—The Lancashire Electric Power Co. has completed its generating station at Oatwood, Radcliffe, and has commenced to lay mains for supply in bulk to various townships, one being along the Rossendale Valley and another *viâ* Swinton and Pendlebury—which local authority has already signed an agreement to take energy—proceeding by Kearsley, Little Hulton, and Westhoughton to the Wigan colliery district.

London.—Islington.—The Electric Lighting Committee of the B.C. was informed by the electrical engineer that a failure of the electric light in a portion of Highbury New Park on the 25th ult., in consequence of which the thoroughfare was left in darkness for some time, was due to atmospheric conditions, but that steps would be taken to prevent a recurrence of the failure. Upon the advice of the electrical engineer it has been decided (subject to the usual sanction) to obtain, at an estimated cost of £112, a Graham-Morton mechanical ash elevator for the generating station. This will, it is believed, save £75 per annum in labour. Application is to be made to the B. of T. for consent to enter into an agreement with the Stoke Newington B.C. to supply at the ordinary rates, electrical energy for six 2,000-c.p., six 500-c.p. and about 50 8-c.p. lamps, for premises on the north-east side of Blackstock Road.

Marylebone.—The Electric Supply Committee, on Tuesday last, presented a report stating that it estimates a deficiency of £12,050—a debit balance on revenue account to March 31st next of £6,050, and an additional £6,000 deficiency up to September 30th next. This latter figure is on the assumption that the Metropolitan Electric Supply Co. will continue to supply the B.C. until September, this being done owing to the fact that it is not practicable to estimate the cost of supply till that date—it depending entirely upon the rate at which consumers can be transferred to the Council's new source of supply. It has been decided to transfer this deficiency to a suspense account. The Committee states that, nevertheless, it hopes that the changing over of consumers to its generating station may begin by May next, and in view of the probable opening of the station in May, the Committee ask sanction for an expenditure of £15,000 as deemed advisable by the consulting engineer, to meet the costs incurred in providing supply. The Finance Committee assented to the Electric Supply Committee's proposals, and stated that a material portion of the £6,050 deficit up to March next is on the stamp on the mortgage of £1,415,000. The B. of T. has fixed the date for the commencement of the Council's 1901 Order to come into operation, and the consulting engineer has submitted certificates for payments to be made to the St. Helens Cable Co., Ltd., of £3,940 and £23,992, being 60 per cent. of the value of cables delivered by the company and now in the stores.

Mexborough.—A L.G.B. inquiry was held recently, relative to the application of the U.D.C. for a loan of £4,000 for E.L. purposes. There was no opposition.

Ormesby.—The U.D.C. has opened negotiations with the Cargo Fleet Iron Co. for a supply of energy in bulk.

Pontardawe.—The R.D.C. is advertising for an electrical engineer, to report on a scheme for lighting the district by electricity for public and private use.

Plymouth.—The price for energy consumed between midnight and 6 a.m. is to be, as from the commencement of the next financial year, 3d. per unit; for power purposes the price is reduced to 2d. per unit instead of 2½d.

Portsmouth.—Messrs. Kincaid, Waller, Manville and Dawson have presented a report to the Electric Lighting Committee of the T.C., embodying a plan for alterations and extensions at the generating station, and have submitted the approximate cost of the work as follows:—Steel chimney shaft, lined throughout with firebrick, 11 ft. internal diameter at the top, with brick base supported on concrete and steel foundations, height above firing floor level, 200 ft., £4,300; alterations to existing flues, forming new flues, with alterations to arrangement of economisers, £485; new pump room, £420; foundations for water-softening plant, £35; removing part of the existing economiser, altering and adding to existing feed-pipes, &c., £350; 20,000-gallon cast-iron feed-tank, fixed and connected to existing suction pipes, £650; water-softening plant, capacity 7,000 gallons per hour, £750; engineering and contingencies, 10 per cent. on £6,990, £699; total, £7,689. It was suggested that the work should be completed by next winter, and should be put in hand without delay. On the recommendation of the Committee, the T.C. has decided that application be made to the L.G.B. for sanction to borrow £8,000 for carrying out the works proposed in the report.

St. Helens.—The Electricity Committee has decided to give an optional charge to large consumers of energy for power, of 2d. per unit up to 2,000 units per month, and 1d. per unit beyond.

Sheffield.—The Corporation E.L. Committee has recommended the T.C. to give six months' notice to terminate the engagement of Mr. Robert Hammond, consulting engineer to the E.L. department.

Slaithwaite.—The clerk has been instructed to obtain information as to the cost of providing electric lighting for the streets.

Southport.—The Electricity Committee has decided to hire out arc lamps at a rental of £1 per annum, and to repair and maintain them at an additional cost of £1 per annum, carbons to be paid for at 4s. 6d. per dozen pairs.

South Wales.—At a recent meeting the South Wales E.P.D. Co. unanimously approved the Bill to transfer to the company the undertaking of the Carmarthenshire Electrical Power Co.

Sussex.—The U.D.C's. of Shoreham, Southwick and Portslade have agreed to take the necessary steps jointly, to obtain a prov. order for E.L. The object of this step is to secure favourable terms with Brighton, or any other body, for a supply of energy, "instead of some authority making a handsome profit out of them."

Tamworth.—The R.D.C. has sealed a petition against the Bill of the Shropshire and Worcestershire Electric Power Co.

Walsall.—The balance-sheet of the Corporation electricity undertaking has been issued, and shows that after paying interest and sinking fund, the profit on the year's working is £1,061, as compared with £316 for the previous year. It has been decided by the Electricity Committee to carry the net profit to the reserve fund.

The E.L. Committee has recommended the Corporation to extend the electric mains along Lysways Street, Mellish Road, Whittimere Street, Rushall Street, Lichfield Street, and Stafford Street at an estimated cost of £1,766.

West Hartlepool.—Sanction to raise a loan of £13,310 for E.L. purposes, has been received by the T.C.

Windsor.—The T.C. has resolved to raise no objection to the application of the Windsor Electrical Installation Co. for powers to supply energy to Clewer Without and Old Windsor.

Worcester.—Mr. T. H. Birrell, chief assistant, reports a loss of £1,221 during the past year. A deficiency of £670 was anticipated by the late Mr. C. J. Sutherland, but owing to an exceptionally bad supply of water-power, this has been exceeded. Mr. Birrell states that since the starting of the Powick station there has never been so little assistance obtained from water power as during the past year. There was a flood in February which lasted 26 days, the turbines then being useless. In May the water supply commenced to fail, and from June 2nd to December 21st a continual drought existed. The units generated last year by water power were 110,744 less than in 1903; 85,000 units more were generated in 1903 than in 1904 by steam and water power combined, and there was an increased coal bill of £101 to generate 85,000 units less. There was also a reduced revenue of £337 from the waterworks motors.

Wrexham.—At a special meeting of the T.C. to inquire into the charges against the electrical engineer, to which we referred in our issue of February 3rd, and Mr. James Wallace, another member of the staff, it was decided to accept the statements that Mr. Sillery had made with regard to some work as correct. Mr. Wallace has, we understand, resigned.

TRAMWAY AND RAILWAY NOTES.

Aston Manor.—The T.C. on 10th inst. adopted a report of the Public Works Committee embracing a scheme which had been prepared by their consulting engineer, Mr. Robert Green, for the reconstruction of the remaining tramways within the borough, including street improvements. The estimate as approved is £63,270, and includes, besides electrical work, the paving of High Street, Six Ways, Birchfield Road, Lovells Road and Witton Road. The scheme for Wheeler Street is in abeyance at present, as it is the intention to equip it in the same way as the Birmingham end of the same thoroughfare. The permanent way will be single track, as at present, with passing places, but the latter will be practically doubled on the engineer's recommendation. The narrowness of the various thoroughfares prohibits the use of double track. The generating plant necessary is now practically complete, as the Council's instructions for it were passed some six months ago, when the General Electric Co. obtained the contract for extensions to present plant.

Belfast.—The Corporation has just effected a loan of one million sterling for the purchase and conversion of the tramway system. The loan has been arranged with the Union and Smith's Bank, London, at 3½ per cent., and the price is £98 per £100, with an underwriting commission of 1 per cent. The full issue will be 1½ millions sterling.

Birmingham.—Major Druitt, R.E., was to inspect the Small Heath electric tram route yesterday. The company, which has practically two years' lease of the route unexpired, will still work the route, and will put on 30 cars immediately sanction is obtained. The company is also supplying energy for this route from its Yardley power station.

Darlaston.—At a meeting of the U.D.C. last week a letter was read from the B. of T., intimating that the South Staffordshire Tramway (Lessee) Co. had applied for a renewal for 12 months of the Board's consent to the use of electrical traction on the line worked by the company in Wednesbury, Walsall and Darlaston. As a result of the discussion which followed the reading of the letter, no objection was offered to the renewal of the licence, but serious complaint was made about the cars, the wretched state of the tramway track, the defective state of the lines, and so forth. It was suggested that the B. of T. should remonstrate with the company on these matters.

Lancashire and Yorkshire Railway.—At the half-yearly meeting Sir George Armytage, speaking of the electrification of the Liverpool and Southport line, remarked that during the half-year they had been gradually completing the service. The increase in the traffic had far exceeded the most sanguine expectations of the directors. In the month of December only, when the dense fogs occurred, they had an increase of 104,000 passengers on this section.

Several improvements have recently been carried out on the railway. Extra fencing has been erected near the Birkdale Station, and in regard to the carriages a trial has been made with two doors opening at the centre, instead of one, and it has been found to be an improvement. On Friday, February 10th, the eleventh set of electric trains commenced running on this railway. It requires 12 sets to work the full and complete service, and one or two steam trains are, therefore, still needed. It is expected that the twelfth and last set will be added shortly. The electric and accelerated service has proved very popular, and the traffic is consequently increasing all along the line, the facilities for getting to the intermediate stations being greatly appreciated. As a safeguard, the Lancashire and Yorkshire, on the 10th inst., commenced to erect spiked iron unclimbable fencing in place of the wooden partitions that used to exist on certain parts of the railway which has been electrified. The new type of fencing will keep dogs from getting through, and will prevent persons climbing over on to the live rail. A considerable number of dogs have been electrocuted, but the new fencing will keep the dogs off the metals, unless they get in from the level crossings.

Liversedge.—A collision occurred on the British Electric Traction Co.'s tramway at Liversedge, last week. A car jumped the points and dashed into one coming in the opposite direction. The fronts of both cars were badly smashed. One of the drivers received an incised wound on the forehead. One of the conductors was knocked down, and several passengers also complained of slight injuries.

Newcastle-on-Tyne.—The estimates for the year ending March 31st, 1906, have just been issued by Mr. T. P. Easton, the acting general manager. He states that he has based his figures on the cost of working at the present time, which he estimates to be 6·75d. per car-mile, or about £2,220 per week. These figures, on being compared with the working costs of other systems similar to Newcastle-on-Tyne, are still high, notwithstanding the economies that have been brought about within the past few months. This, Mr. Easton says, is largely accounted for by the fact that the cost of working the traffic department comes out at 3·89d. per car-mile. The following figures show that this amount is excessive:—

Glasgow	traffic expenses	..	..	2·89d.	per car-mile.
Salford	,, ,,	..	..	2·92d.	,, ,,
Liverpool	,, ,,	..	..	2·97d.	,, ,,
Nottingham	,, ,,	..	..	3·01d.	,, ,,
Leeds	,, ,,	..	..	3·13d.	,, ,,
Manchester	,, ,,	..	..	3·36d.	,, ,,
Sheffield	,, ,,	..	..	3·89d.	,, ,,
Newcastle	,, ,,	..	..	3·89d.	,, ,,

Mr. Easton continues: "The average traffic receipts for 45 weeks of the present year equal £3,660 per week, upon which figure I have based my calculations to arrive at the estimated traffic receipts (£190,320) for the ensuing year. By the addition of the receipts receivable from the Lighting Committee, the amount is brought up to £194,737." The estimated expenditure is put down at £115,265, so that the balance is £79,472. The sum of £10,131, representing the estimated expenditure for repairs and renewals to the tramway track, must be added to the expenditure given above, making a total of £125,396. This reduces the balance to £69,341, out of which is to be taken the sum of £67,142, the estimated amount for interest and redemption. This brings the balance to £2,199.

Manchester.—On February 8th the Corporation decided to adopt a parcels carrying scheme on the electric tramways of the city. Parcels will be dispatched every quarter of an hour, and taken to their destinations by boys or in carts. The charge for the inside area will be 2d. to 6d. for 14 lb. and 112 lb. respectively, and delivery in the outside area will be from 3d. to 8d. for those weights. On 7th inst. the Tramways Committee decided to give an order for two motor-omnibuses, which, if successful, will supersede the horse-drawn vehicles which now ply on the Northenden, Cheadle and Chorlton-cum-Hardy routes. The petrol-driven buses will be tried on the route from Northenden to Palatine Road, Withington.

Partick.—At a meeting of the T.C. particulars of the deadlock with the Glasgow Tramway Committee over the electric tramway extensions were made known. The Tramway Committee purposed lowering the levels of Dumbarton Road under two railway bridges, so as to allow covered cars to pass underneath, and to construct new tramways along several roads. The Partick authorities asked the Tramway Committee to carry out and maintain car-

tain necessary drainage. The Corporation offered to put in some gullies, but declined to maintain them or the connecting drains.

London.—LONDON COUNTY COUNCIL.—At the meeting on Tuesday a statement was submitted, giving the cost of settling claims in respect of accidents in connection with the Council's electric tramways for the nine months ended December 31st, 1904. It appeared that the actual expenditure for that period had been £6,400, and on this basis the outlay for the year 1904-05 would probably be about £8,533, whereas the amount provided in the estimates for this purpose was £10,000 for the year. The cost for the nine months worked out at ·188d. per car-mile, as compared with ·264d. in 1903-04.

The Highways Committee reported that in addition to the use of condensed steam, and the water obtained from the artesian well, for the supply of water for feeding the boilers at the Greenwich generating station, arrangements had been made for procuring an independent supply of water from the Metropolitan Water Board in the event of any portion of the condensing plant temporarily breaking down. The Board had undertaken to deliver the water required at a quarterly rent of £25, and the payment of that sum would entitle the Council to take a total of 736,000 gallons a quarter at a rate of supply not exceeding 25,000 gallons an hour, and for any additional quantity required, the Council would have to pay a further 7½d. per thousand gallons.

The Parks Committee stated with regard to the arbitration in the matter of the easement affecting the Victoria Embankment Gardens to be acquired by the Metropolitan District Railway Co., in connection with the construction by it of an electric sub-station adjoining its Charing Cross station, that the arbitrator, Mr. Howard Martin, had issued his award under which the company must pay to the Council £1,700 as representing the value of the easement in question, with interest on this sum, from September 14th, 1903.

Plymouth.—The T.C. has received from the L.G.B. sanction to raise the loan of £6,450 for the construction of an electric tramway in Saltash Road, and the electrification of the Coburg Street and Pound Street track.

Sunderland.—At the meeting of the T.C. on the 8th inst., Mr. T. Summerbell, the chairman of the Tramways Committee, stated that the Committee had decided to appeal to Quarter Sessions against the assessment of the tramways. He regretted this because it would place them in conflict with another authority, and the interests of the ratepayers would be affected, no matter which side lost the appeal. He thought it was within their right to know how the percentages on which the assessment was based were made up. The Assessment Committee refused to give them the information, and they had no alternative but to go to Quarter Sessions.

A statement was recently made by the Town Clerk of Sunderland to the local Press as follows:—When the Corporation decided to give notice of appeal the assessment stood at £14,129; afterwards an alteration was made to £13,129, on the grounds that the former was based on the accounts of the system for the year ending March, 1903, and the latter for 1904. But the peculiarity as regards this alteration is that the receipts which formed the starting basis of these assessments were in 1903 £59,284, whilst in 1904 they were £62,597, so that as the income grew the assessment decreased. Then on the 2nd inst. the further reduction was made on the same basis of 1904 from £13,650 to £11,000. The Corporation contends that the Assessment Committee has no sure, solid and abiding foundation on which it bases its assessment of such undertakings, and that these repeated reductions and alterations of position are clear proof of this contention. The absence of confidence by the Committee in its own decisions is shown by its actions in another respect. Whilst the Corporation has throughout placed every figure of its accounts at the disposal of the Committee, it only with great difficulty obtained from the latter the details of the first and second altered assessments, but as to the third (that for £11,000) upon being at once asked for the like information, the Committee replied that it had already decided not to give it, as that would be giving away its case, a truly extraordinary admission, indicating how weak the case is felt to be.

Tramway Incidents in Court.—At the Bristol County Court on the 1st inst., the Bath Electric Tramways, Ltd., were sued for £150 damages for the loss of a horse. It appeared that plaintiff's horse was being led down a narrow thoroughfare, and was overtaken by a car. The horse by some means got in front of the latter, and was so severely damaged that it had to be killed. The jury found a verdict for the plaintiff for the amount claimed, attributing the accident to the car driver failing to keep a proper look-out.

At the Manchester County Court, on the 13th inst., Mrs. Grace Allcock was awarded 3 guineas and costs against Messrs. Sutton and Co., carriers, for damages received through defendant's' van becoming entangled with the trolley rope of a car on which she was riding.

At Longton, on the 13th inst., Esau Oakes was charged by the Potteries Electric Traction Co. for having removed the trolley pole from the wires when the car was being driven up High Street on the 28th ult. Defendant pleaded that he was drunk at the time. He was fined £3 and costs.

Wolverhampton.—The Tramways Committee has decided not to lay down a tramway in Victoria Street, Worcester Street, and Lea Road, to the borough boundary at Renn Fields, but to serve the locality by means of motor 'buses. The total inclusive capital cost of a tramway would be approximately £17,455, whilst the total capital expenditure involved in initiating a motor-omnibus service to give the same car-mileage would be approximately as follows:—Three double-deck motor-omnibuses to carry 36 passengers, at £950 = £2,850; allow for petrol storage tanks, &c., at car depôt, £200; total, £3,050. The Committee has instructed the engineer to prepare specifications and obtain tenders for three double-deck petrol omnibuses. Each 'bus will be provided with a 30-B H.P. petrol engine, and will be capable of a maximum speed of 14 miles per hour. The recommendation is under consideration, though it is stated that there is no doubt that it will be finally adopted.

TELEGRAPH AND TELEPHONE NOTES.

Brighton Telephones.—Yesterday a report was to be laid before the T.C. regarding the expenditure on the telephone system in excess of Mr. Bennett's estimate, which amounted to £6,217. The report, which was signed by Mr. D. J. Barnes, engineer and manager, recommended that sanction be obtained from the L.G.B. to a loan of this amount. There were a total of 1,709 completed lines, and 1,229 partially-completed lines, and the spares were so few that it was imperative to supplement the underground cables in Hove at once in every direction, and a loan of £5,400 was recommended for this purpose. The net profit was estimated at £80 per month.

Cable Codes.—On July 1st last the new Rules and Regulations, passed at the London Telegraph Conference in 1903, came into force, and have now, therefore, been on trial for seven months. The attitude taken up by us as to charging for telegrams, and especially as to the regulation whereby the combination of ten letters was permissible so long as they were pronounceable according to any of the authorised languages, was unmistakable, and there was no hesitation on our part in stating that the regulation paved the way for as much confusion in the future as in the past; and, so far as we can learn, there is much friction existing between companies, the public, and every other department concerned. Let us assume that a code telegram is handed in containing such words as "Meryxmas," "Vladostock" and "Africapunt." The rule provides that these three words must be charged as six words, viz., "Merry Xmas," "Vladivostock" (12 letters) and "Africa Punt." When challenged, the sender claims that they are code words or pronounceable groups of letters not exceeding 10 in number, and here we have a deadlock. Government lines adhere strictly to the rules, and companies probably give a broader definition; all are equally in order, but the rule is so wide, and so much is left undecided, that it seems absolutely unworkable without friction, and, therefore, it becomes an impracticable rule. We would say once more that the best way to obtain a definite rule is either to compile and issue a vocabulary of authorised combinations least liable to error in transmission—probably best on the "Nicolson" system—or charge "per letter" and take in everything that comes along, only advising the sender that the more mixed it is made, the less chance he gives to the operator to transmit his telegram correctly.

Taxing Cables.—A Honolulu dispatch to the *Chronicle*, Halifax, N.S., states that the Supreme Court of Hawaii has decided that the 6 miles of trans-Pacific cable, within the 3-mile limit below low water mark, is taxable as personal property. The company made no return of the cable. The assessor valued it at $42,800, and the Supreme Court at $16,000.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1903	
St. Lucia-Martinique	May 7, 1903	
Cayenne-Pinheiro	Aug. 13, 1903	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostok-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chifu	Mar. 9, 1904	
Paramaribo-Cayenne	July 13, 1904	
Jamaica-Colon	Jan. 5, 1905	
Marmaritza-Rhodes	Jan. 30, 1905	
Martinique-Paramaribo	Feb. 14, 1905	
Landlines.		
Cartagena-Baranquilla	Dec. 8, 1900	Feb. 10
Puerto-Barrios	July 28, 1902	
Kertch-Soutchoum	Sept. 27, 1904	
Rome-Pera	Jan. 27, 1905	
Bhamo route beyond Tali	Jan. 15, 1905	
Newfoundland—all places in the interior	Feb. 10, 1905	
Fao route beyond Bassora	Feb. 13, 1905	

Telephone Disputes.—At the Tunbridge Wells County Court on the 8th inst., the case of the National Telephone Co. *v.* Ernest Booker was heard. The plaintiffs claimed £4 5s. 4d. for the use of telephone and party-line fees. It appeared that although they disconnected defendant in February, a claim had been put in up to May. After a lengthy argument, his Honour decided that disconnecting the service of a subscriber was identical with terminating the contract, and it precluded any subsequent claim for further payments, so the claim was dismissed. Leave to appeal was declined, unless the company paid costs. In the Aberdeen Court of Session on January 31st, Lord Low closed the record in an action by the National Telephone Co. against the Aberdeen Suburban Tramways Co. for payment of £722 15s., on account of alterations to telephone lines, rendered necessary by the construction of the tramways. The defenders pleaded that the work was not carried out with their sanction, and that the pursuers were barred from insisting in the action, through their claim not having been timeously

made. The case was sent to the Procedure Roll. In the Sheffield Court on the 7th inst., the magistrate decided that the G.P.O. had a right to fix a pole in St. Philip's Road, as opposed to the views of the Corporation.

Portsmouth Telephones.—The Borough Treasurer has reported as to the financial position of the telephone undertaking that the amount sanctioned by the L.G.B. was £34,488, that payments had been made amounting to £37,187, and outstanding amounts were £415, the amount over expended being £3,114. The Finance Committee of the T.C. has been asked to allow the Telephone Committee to open a suspense account and allocate a sum to be agreed on yearly for the repayment of that account.

Very Like a Whale.—The *Herald*, Halifax, N.S., states that when the end of the Sitka-Valdez cable was raised at Sitka, the cable ship *Burnside*, repairing the break, found a whale was attached. This paper further states that the whale had got a hard bite of the cable, as its jaws were said to be firmly fixed in the latter. This would remind one of the chicken which had bolted a bean attached to a string, and after swallowing for some hours, was brought up standing in front of a post to which some malicious boy had fastened it.

Wireless Telegraphy.—Mr. Simpson has succeeded in establishing communication between Diamond Island on the Bassein Coast and Slipper Island, Andamans. Messages passed satisfactorily for the first time on January 12th and 13th.—*Indian Engineering.*

The rules for wireless telegraphy laid down by the French Government apparently differ from those in force in Great Britain, and some of the chief points are as follows:—The word "Radiotélégramme" must appear before the address, and is charged for. Convention rules apply to these telegrams. The address of telegrams to ships at sea must give the name or official number of the ship and its nationality. Demands for assistance from ships at sea are given priority over other telegrams. The sender of a wireless message to a ship at sea may stipulate that it be held for a certain number of days by the coast station. For this purpose he must insert before the address and pay for the words "*x* days," specifying the number of days. Should the ship not get into touch with the coast station within the time fixed by the sender, he is advised, and he may by paid service or postal advice to the coast station order the telegram to be held for a further period of 30 days, and so on. The rate is 75 centimes per word to the coast stations at Ouessant and Porquerolles for the present, as well as for other stations on the coast of France, Algeria and Tunis, and telegrams to or from ships at sea may only be accepted for these places, Monaco and Vallées d'Andorre.

CONTRACTS OPEN AND CLOSED.

OPEN.

Army Contracts.—The Secretary, War Office, is advertising for names of manufacturers who wish to tender for army requirements. See "Official Notices" February 3rd.

Austria.—The municipal authorities of Vienna are about to invite tenders for the supply of 10 electric motor tramcars and 100 trailer tramcars.

Batley.—February 20th. Tenders are required for wiring and fittings in connection with the electric light installation at the new central stores, now erecting for the Batley Co-operative Society, Ltd. Harry B. Buckley, Architect, 85, Commercial Street, Batley.

Battersea.—February 27th. Coal and other stores for the electricity department. See "Official Notices" February 10th.

Belgium.—March 1st. The Belgian State Railway authorities, at La Bourse, Brussels, are inviting tenders, until March 1st, for the supply of the plant required for the electric lighting of the railway stations at Chenée, Aguesses and Angleur.

Dublin.—February 23rd. Arc lamp carbons for the Corporation. See "Official Notices" February 3rd.

East Ham.—February 21st. Five double-deck roof-covered cars, complete. See "Official Notices" February 10th.

France.—February 25th. Tenders are being invited until the 25th inst., by the municipal authorities of Dax (Landes), for the concession for the public and private lighting of the town by gas and electricity during a period of 35 years. Tenders are to be sent to La Mairie de Dax (Landes), whence particulars may be obtained.

Fulham.—February 22nd. Condensing plant, boilers, economisers and stokers for the Electricity Department. See "Official Notices" February 10th.

G. W. Railway.—March 13th. Plant (three-phase and direct current) for the proposed sub-stations and distributing centres in connection with the Park Royal generating station. See "Official Notices" February 10th.

Hull.—March 1st. Mains and cables for one year. See "Official Notices" to-day.

Ilford.—February 27th. Coal, meters, cables, lamps, &c., for one year. See "Official Notices" to-day.

Islington.—February 23rd. Electrical and engineers' stores for the electricity department. See "Official Notices" February 10th.

King's Lynn.—February 28th. One 200-KW. steam dynamo, condenser, pipes &c. See "Official Notices" to-day.

Johannesburg.—March 6th. 100 electric cars, two electric water cars, five-ton crane, car traverser, and workshop tools, for the Municipal Council. See "Official Notices" December 30th.

Kilkenny.—February 20th. Installation of tell-tales for the District Lunatic Asylum. See "Official Notices" February 10th.

Leek.—February 20th. Wiring and fitting the Town Hall for the U.D.C. See "Official Notices" January 27th.

Lowestoft.—March 9th. One water-tube boiler with superheater, brickwork and accessories, and pipework. See "Official Notices" to-day.

Manchester.—February 21st. Motor-generators and five-wire balancers for the electricity department. See "Official Notices" February 3rd.

Newport (Mon).—March 6th. 300-KW. continuous current tramway generator; 200-KW. continuous current steam balancer; one (straight tube) water-tube boiler and superheater; marble switchboard; extension of switchboard gallery; general stores including lamps, carbons, Engine room stores and electrical stores &c. See "Official Notices" to-day.

Porto (Portugal).—March 15th. The Town Council has opened a competition for the concession for the exclusive right of working the tramways for collective transports of passengers, luggage, and goods in all the municipal public ways. The conditions of the competition are published at the Portuguese Consulate in London.

Rathmines.—February 20th. Coal and other stores for the electricity department. See "Official Notices" February 10th.

Rochdale.—February 22nd. Sub-station plant, three 120-KW. motor-generators; high tension three-phase switchgear; low tension, continuous current switchgear. See "Official Notices" to-day.

Salford.—February 18th. Stores, &c., for the electricity department. See "Official Notices" February 3rd.

Salford.—March 4th. Alterations to batteries. See "Official Notices" to-day.

Shanghai.—March 31st. Construction and working of 24 miles of electric tramways on the trolley system, double or single. See "Official Notices" October 14th.

Sheffield.—February 18th. Tramway stores. See "Official Notices" February 3rd.

Spain.—March 1st. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until March 1st for the concession for the establishment and working of a telephone exchange in Albacete. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid.

South Shields.—February 20th. Permanent way and construction of track; rail bonds and bonding; conduits, cables, and overhead equipment for the Corporation. See "Official Notices" January 13th.

South Shields.—March 13th. Boiler, two vertical engines and 550-KW. traction generators, also traction switchboard for the Corporation. See "Official Notices" February 10th.

Stoke Newington.—March 8th. Transformers, motor-generators, boosters, switchboards, battery, distributing mains. See "Official Notices" February 10th.

Sunderland.—February 24th. Four 250-KW. synchronous three-phase motor-generators for the Electricity Department. See "Official Notices" February 10th.

Swindon.—February 21st. Extensions to lighting switchboard, switch-panels, &c. See "Official Notices" February 3rd.

Willesden.—February 28th. Maintenance of telephones for the D.C. See "Official Notices" to-day.

Wimbledon.—March 4th. Stores for the electricity department. See "Official Notices" February 10th.

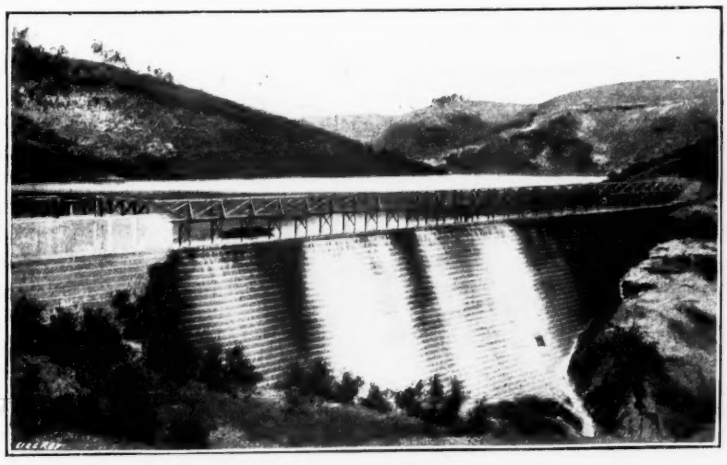
Yarmouth.—March 1st. Two water-tube boilers, and a 300-KW. steam alternator. See "Official Notices" to-day.

(Continued on page 273.)

INDIAN ELECTRIC LIGHT AND POWER PLANTS.

ELECTRIC PLANT OF THE NILGIRI CORDITE FACTORY.

When the Government decided to build a cordite factory in India, the Nilgiri Hills in the Madras Presidency were chosen on account of the very even temperature they enjoy. A site having been selected near Wellington, it was seen that there was an abundance of water-power available, and it was decided to install an electric plant and to utilise the Karteri falls, some 3·5 miles distant, to supply the power.



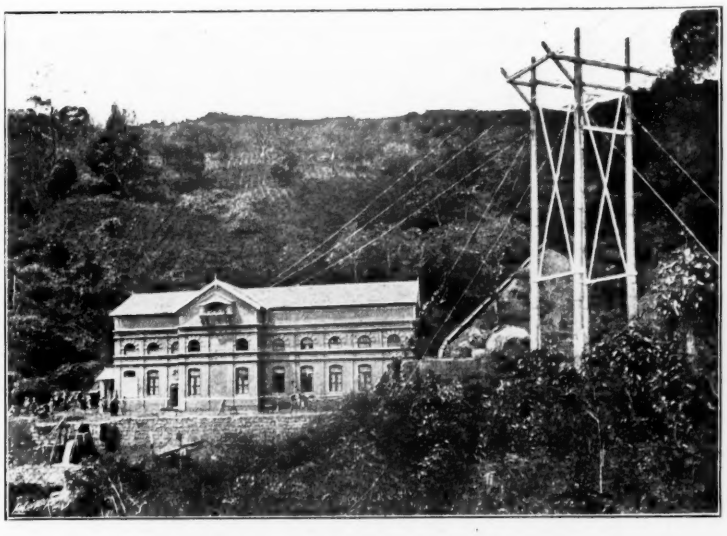
Karteri Falls: Reservoir and Dam.

Tenders having been called for, the whole contract for the electrical and hydraulic plant was awarded to the General Electric Co., Ltd., of London, Birmingham and Manchester, a firm that has taken a leading part in polyphase work in this country.

The dam forms a reservoir containing 7,500,000 cb. ft. of water, and has a catchment area of some 10 sq. miles; the absolute minimum flow of water in the streams above the dam has been calculated at 181·5 cb. ft. per minute, and this minimum has not been reached since 1877, when there was a drought of over 4½ months; the supply would last for some 45 days of 12 hours, using 600 cb. ft. per minute, which is, as far as can at present be ascertained, at least 30 per cent. more water than will actually be wanted, about 450 ft. per minute being nearer the average used when working. With the present height of dam it is probable that, for 11 months in the year, 24 hours daily could be worked for six days in the week, and 12 hours for the 12th month in an exceptionally dry year; but the dam has been designed so that another 8 ft. can be added to its height, which would enormously increase its storage capacity, and would allow a 24 hours' run for the whole year. The effective fall from the dam to the power house below the falls is 624 ft., which gives nearly 1 H.P. for every cubic foot per minute.

The pipes for carrying the water from the dam to the power house are 24 in. in diameter, and are of double riveted steel, running from $\frac{3}{16}$ in. to $\frac{7}{16}$ in. thickness as the pressure becomes greater; these pipes were supplied by Messrs. Gunther and Sons, of Oldham, England, and are laid on concrete piers. Special anchor bolts have been provided for the steeper parts of the line.

At the back of the power house is the receiver pipe, 30 in. diameter, 37 ft. 6 in. long; on this receiver pipe are fixed a relief valve and two air vessels, which act as a cushion when there is any water hammer owing to a rapid change of load. From this pipe are taken six branch pipes (each fitted with a relief valve) to the turbines in the power house.



Power Station and Transmission Line.

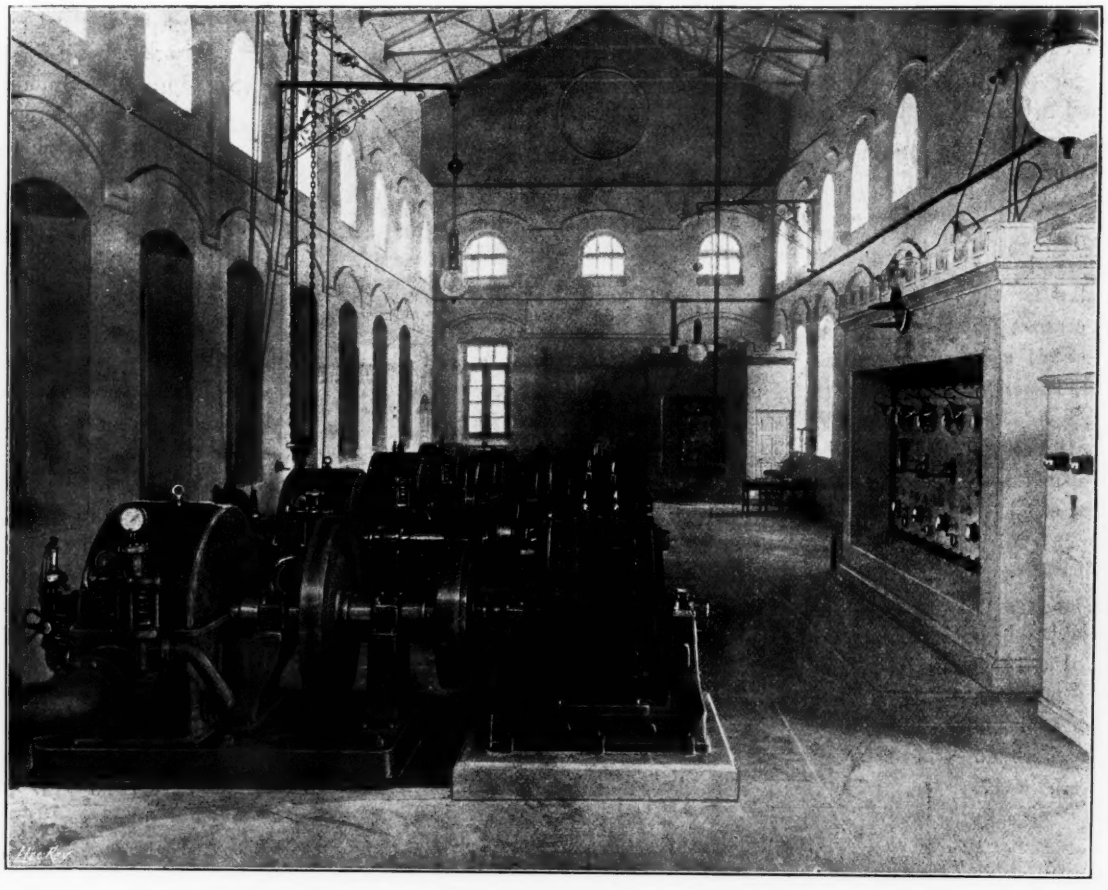
The turbines, manufactured by Messrs. Gunther & Sons, are six in number, and are of the modified Girard type, fitted with the maker's hydraulic governors, which keep the speed constant from no load to full load, and allow half load to be thrown off with a momentary rise in speed of less than 3 per cent. The four larger ones are each capable of giving 230 brake H.P. with an effective fall of 600 ft. and 270 c. ft. of water per minute; the bucket wheels are 54 in. in diameter, and the turbines run at 400 r.p.m. They are directly coupled to four G.E.C. three-phase generators of 125 KW. output, generating current at a voltage of 5,000 between any two terminals of the star-wound armature; they are of the revolving field type with 12 poles, giving at 400 r.p.m. a frequency of 40 cycles per second.

The two smaller turbines of 37 H.P. each at 800 r.p.m. are

directly coupled to two continuous current dynamos (one spare) which excite the field magnets of the alternators and also light the power house, which is equipped with three G.E.C. Angold continuous current arc lamps inside and one over the main door outside; there are also five 16-c.p. incandescent lamps on the high tension switchboard, and two on the low tension continuous current board.

The three-phase generators run in parallel through the high tension switchboard to the bus-bars. Insulated cables mounted on porcelain insulators connect the bus-bars to the overhead transmission line, which terminates in the opening of the cable tower built for that purpose; as the line leaves the power house at an angle, a bracket had to be erected to prevent the wires from coming into contact with the hood over the opening of the tower.

The transmission line between Karteri and the cordite factory passes over very hilly country and across two streams, and the span over the river at the power house has a quadruped to support the wire, the distance being some



Interior of Generating Station: Gunther Turbines driving G.E.C. Alternators.

180 ft. The average span is about 100 ft.; the line is supported by galvanised iron masts, made up of the larger sizes used by the Indian Telegraphic Department, with three cross-arms on each post to take the wires. The cross-arms are of wood, securely bolted on to the post and strengthened with a wooden stay; they are arranged two on one side of the post and one on the other, so that the three wires form an equilateral triangle, each wire being 1 metre from the other two, and are mounted on triple petticoat high tension insulators, made by Messrs. Bullers, Ltd.

The wire, which is No. 1 S.W.G. hard drawn copper, in one mile lengths, is connected with the ordinary twist joint, or what the Americans call the "Western Union," and well soldered.

The cordite factory covers a piece of ground roughly 1 mile long and $\frac{1}{4}$ mile in breadth; in as central a position as possible is situated the transformer house, which contains a high-tension switchboard, four three-phase step-down transformers, each of 120-kilovolt-amperes output, a low-tension transformer board and a distributing board to the different sections of the factory. The transformers receive current at 5,000 volts on the high-tension side, mesh connected, and give 380 volts on the low-tension side with star connection, the pressure between any one phase and the neutral point being 220 volts; this is the pressure used for lighting the factory. In the transformer house choking coils have been placed in the neutral wire circuits, so that the pressure can be regulated on the different branches of the lighting circuits separately and as required; the lighting is arranged so that it shall balance equally on the three phases as far as possible.

The cables in the factory are underground, and are laid on the British Insulated Wire Co.'s solid system. They are of the three-core type, insulated with impregnated paper, and lead covered, and they are placed in earthenware troughs 2 ft. long, filled up with pitch. The troughs have small bridges on which the cables rest, so that the pitch can run all round the cables.

The three-phase induction motors are of the G.E.C. standard type, 18 in number, and consist of seven of 45 B.H.P., two 28 H.P., four 18 H.P., two 6 H.P., and three 3 H.P., the larger motors running at 800 r.p.m., less slip, and the 3 H.P. and 6 H.P. at 1,200; all the motors, except the 3 H.P., are provided with starting resistances in the rotor circuits.

The cables used for wiring the buildings are Messrs. W. T. Glover's, of Manchester, and are vulcanised, taped and braided. In the non-danger buildings all the wires are run on small insulators fixed to the walls, so that all connections can be seen; a short circuit is practically impossible except at the lamps, ceiling roses, &c., and danger from fire is brought down to a minimum. In the danger buildings all the wires are run in insulated steel conduit, the joints being red leaded so as to make them thoroughly air-tight. Special airtight fittings to hold the lamps are provided, and all the conduits are well earthed.

The power house and transformer house have been built large enough to take another unit each, and the pipe line and overhead transmission line will carry a considerable increase

of power in the event of the output of the factory being increased.

The Government is to be congratulated on having determined to give an English firm the contract, in spite of the prevalent, though erroneous, idea that we are years behind other countries in the electrical line; we understand that the plant, which has now been working for some six months, has run absolutely without a hitch of any sort, and has given every satisfaction.

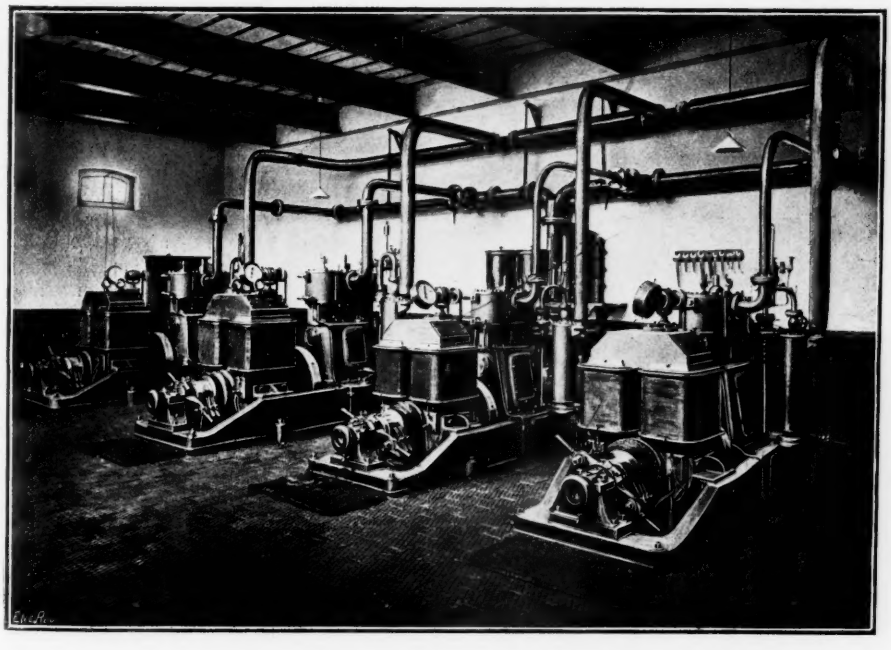
THE DACCA ELECTRIC LIGHT TRUST.

By R. STANLEY SMITH.*

Dacca, a large and important native town in a district of the same name, situated in Eastern Bengal, is one of the few places in India that, three years ago, could boast of a public electricity supply of their own.

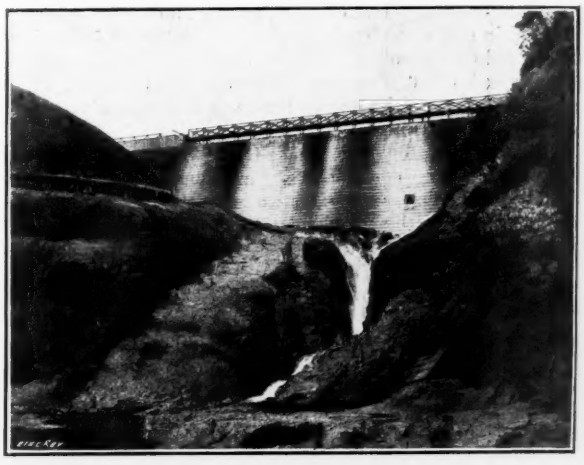
The undertaking had its origin in the enterprise and munificence of the late Nawab Ahsunollah Khan Bahadur, who was at the time considering a project for the installation of a private plant in his palace.

The first idea that occurred to him was to have the mains extended through the principal thoroughfares of the town, so as to afford the public, or, at all events, the Europeans and the wealthier native residents, the opportunity of sharing with him the benefits of the supply at a certain charge per unit, which he, in common with them, could agree to pay towards the upkeep of a central establishment. From this he was led to a generous offer of the current to the Municipal Commissioners to replace oil for street lighting purposes, at a cost which he agreed at his own expense to keep within the margin of their existing expenditure. And in order that no one, however poor, might be entirely excluded from the advantages such a supply could offer to residents in their own houses, he further agreed to install, in the premises of all *bonâ fide* shopkeepers and tradesmen, any number of lights they might require, in consideration of receiving from them a nominal monthly charge per lamp for the hire and lighting of the same.



Dacca: Interior of Engine Room.

It is not an easy matter to distinguish the very fine line that is drawn, in an arrangement of this sort, between generosity and speculation. So much of the one may be covered by the other, as the various sources of income are drawn into the one account. But when it is considered that the ordinary rate fixed upon for consumers was uniformly 5d. per unit—it is 8d. for lighting and 4d. for power in Calcutta—and that the street- and shop-lighting promised barely sufficient to pay for its production, it will not appear surprising that the Nawab found it necessary to prepare for a deficit, and to meet depreciation and other incidental losses with a reserve.



Nilgiri Cordite Factory: Dam and Pipe Line.

A scheme, embodying these proposals, was drawn up before a specially appointed board of trustees, who were supplied by the Nawab with the necessary funds to carry it through. He himself was an honorary member of the Trust, and his chief manager was hon. secretary.

No tenders were invited for the supply and erection of the plant. Messrs. F. & C. Osler, of Calcutta, were asked to accept the contract on certain agreed-upon terms, and the sanction of the Local Government having been obtained, the order was placed with the firm for execution.

The system is identical with that of Calcutta—a three-wire direct-current supply with batteries, carrying a pressure of 500 volts between the outers, and having the middle wire earthed.

For the purpose of balancing, three separate means have been provided, which may be used either individually or in combination:—(1) The regulating cells of the batteries. (2) A couple of steam dynamos in series, one on each side of the system. (3) A motor-generator or balancer proper, which may be used at the same time for boosting up the pressure on the charging circuit of the batteries, and may be on this account more correctly styled a balancing-booster. These are all installed on the premises of the power station, and regulated from the same board.

The switchboard, which is fitted with N.C.S. meters and the latest improvements in switching and controlling gear, is of white marble framed in varnished teak; with its polished mountings, it forms a fitting ornament to the

* Late chief engineer to the Trust.

engine room. The feeder circuits on it are all provided with fuses, and the machines with automatic cut-out switches of the carbon-tipped "I.T.E." pattern.

The batteries were supplied by the Chloride Syndicate, 272 cells in all, with a total capacity of 720 ampere-hours, and an ordinary maximum charge and discharge rate of about 60 amperes on either side.

The steam dynamos consist of four Parker-Belliss direct-coupled sets, capable of generating 150 KW. The dynamos are shunt-wound. Two of these, giving 250 volts each, are coupled in series, as already described, and two of 500 volts in parallel on the outers. The engines are enclosed, running at a speed of 600 r.p.m. with forced lubrication, and are fed by three of Marshall's loco-type boilers at a pressure of 150 lb. per sq. in.

Two Worthington pumps and a Green feed heater complete the steam-raising equipment. An electric motor pump is installed on the river side, about a quarter of a mile distant, to supply the settling tanks on the station with water, it having been found that the pressure of the local water supply is insufficient for the purpose.

The load on the power station is distributed among five feeders, four of which are carried overhead to the respective centres in the town, and the remaining one direct to the Palace. On account of considerations of pressure-drop, a special change-over switch is fitted in the engine room for connecting the Palace circuit with one of the town mains when necessary, and a pair of pilot leads are run back from one of the distribution centres in the town to an electrostatic voltmeter on the switchboard.

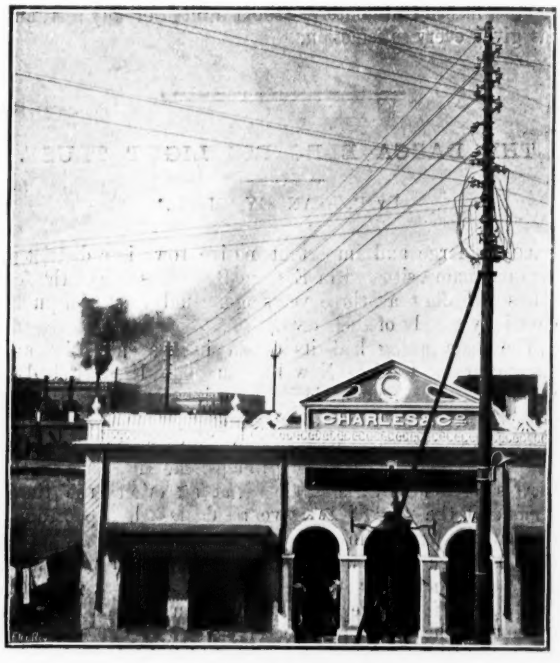
In India, generally, where the drainage systems are still far from perfect, the rainfall abnormal, and the thunderstorms the worst that can possibly be imagined, it becomes difficult for the electrical engineer to choose between an overhead and an underground distribution. In Dacca the feeders and mains alike are all overhead—bare hard-drawn copper, the thickest section in any part being No. 00 S.W.G. These are carried along the sides of the streets on tubular wrought-iron poles, which are fitted to cast-iron bases and sole-plates, and embedded in concrete. The pole in the illustration has, since the photograph was taken, been replaced by a double one, which was required to stand the rapidly increasing strain that was put upon it. It now carries 12 wires, varying in gauge between 00 and 4 S.W.G. The house services are tapped from the poles through single fuses, and are led by means of duly protected service brackets into the consumers' premises. Strapped to each pole at a height of 12 ft. from the ground, is a Dorman and Smith street lamp bracket, fitted with fuse, well-glass shade, enamelled-iron reflector, and 50-C.P. lug lamp.

There are nearly 200 of these in use, extending over a total distance of 6 miles.

It has already been remarked that the distribution area is divided into four districts, supplied by four separate feeders. If necessary, these may be at any time connected up into the general network by inserting fuses at the points where the mains of contiguous districts meet. One of the fuse-boxes for this purpose may be seen on the pole in the accompanying illustration.

Lightning guards are liberally disposed about the supply area, and in the cable room at the engine house, where the feeders enter the building, each is led through a Siemens horn arrester and kicking coil, and then again through an Ajax arrester in the cable room, before it is permitted to descend to the bus-bars.

In regard to the load, the highest peak in the curve may be looked for in the early part of any night in the hot season of the year, just before the break of the monsoons,

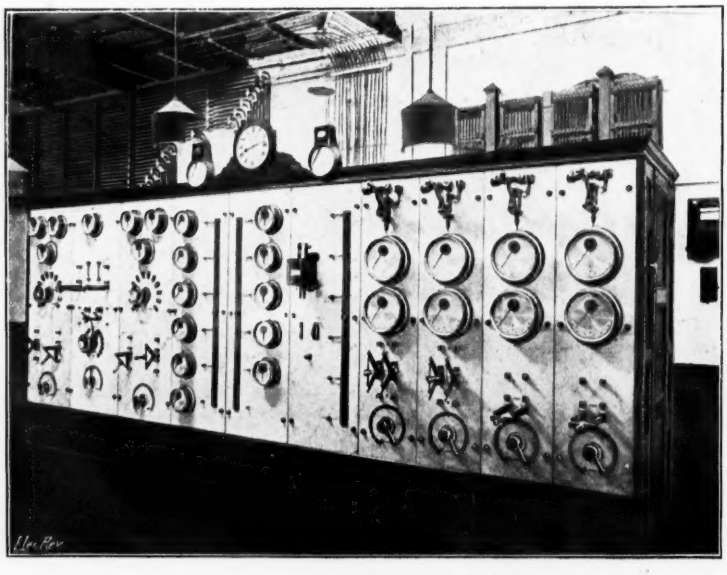


Overhead Mains.

when the combined lighting and fan-load is at its maximum. The same characteristic may be observed in a day-light curve to mark the approach of a "nor'wester." A storm of this kind will come on sometimes with as little warning as a London fog, and leave again with as little ceremony, but with a good deal of damage behind it.

The curve is otherwise regular and profitable, till the cold weather sets in. The disturbances in its regularity then begin to give way before the more serious disturbances in its profitableness.

The cold weather in the tropics is not the winter of fog, and rain, and darkness, that it is at Home. It is a season of hay-making. The nights are not too long, and the days are unbroken intervals of coolness and sunshine—the sort of sunshine that is least conducive to hay-making as far as the electricity supply companies are concerned. And it is at this season of the year, when fans are never used, and during day-light hours, when the leakage on the mains begins to figure out to an alarming percentage of the output, that the mind of the engineer is most sorely exercised in devising various expedients for economy. He would shut down, but that the law demands that not more than 20 per cent. of the consumers shall be cut off at one time through any cause that is not directly attributable to an "act of God." What a



Main Switchboard.

glorious opportunity to throw his two sides of the system into parallel on one of the batteries, and cut the other out! But, alas, for the Chamberlain and Hookham meters that are used on the consumers' services; half of them would undo the profits of the other half! Why have we not a unit-meter of the kind that will register a continuous current on reversal?

CONTRACTS CLOSED.

(*Continued from page* 268.)

Burslem.—The T.C. has accepted the tender of Messrs. Babcock & Wilcox, for steam piping and pump for the Electricity Works, at £621.

Erith.—The U.D.C. has accepted the following tenders in connection with the tramways:—

Brush Electrical Engineering Co., Ltd., overhead equipment, poles, &c., £4,217.

Callender's Cable & Construction Co., Ltd., feeder cables, &c., £2,590 4s., with £51 16s. for additional two years' maintenance.

British Westinghouse Electric & Manufacturing Co., Ltd., rotary converters, &c., £1,545 5s.

Glasgow.—Messrs. Mountain & Gibson, of Bury, have secured the contract from the Corporation Tramways Department for 100 of their "M.G." 21 E.M. electric motor trucks for tramcars fitted complete with steel-tired wheels and steel axles. These trucks are for 100 new cars which the Corporation is building and putting into service.

After several sittings to consider the various tenders submitted for electric coaling hoists for Clydebank Dock, the Clyde Navigation Trustees have accepted an amended tender of Messrs. Nagel & Kaemp, for two hoists and relative generating plant, spare plant and gear.

The Craigpark Electric Cable Co. has received an offer from the Clyde Navigation Trustees for electric cable.

The Tramways Committee of the T.C. have accepted the following offers:—Traction poles, Wilsons & Union Tube Co., Ltd.; machine tools, Oliver Machinery Co., Manchester; motor trucks, Messrs. Mountain & Gibson, Bury. Pinkston Power Station—guards for coal conveyers, P. & W. MacLellan, Ltd.

Hospital Plant.—Messrs. R. J. Nicholson & Co., of Manchester, have secured the contract for the electric light installation at the Isolation Hospital, Leftwich, near Northwich. In addition to the fitting of the various blocks, the contract includes a distribution system of underground mains.

Leicester.—The T.C. has affixed the common seal to a contract with Messrs. Yates & Thom, at £6,062, for two boilers and boiler-house appliances at the tramways main power station.

Marylebone.—The Borough Council has accepted the following tenders:—Supply and maintenance of storage battery at the new generating station, Electrical Power Storage Co., £2,418, and £88 per annum for maintenance; construction of the staircases, flooring and grating of the engine room at the new generating station, C. A. Parsons & Co., Newcastle-on-Tyne, £2,962.

Middleton (Lancs.).—The Council has resolved upon the erection of a refuse destructor to work in conjunction with the electric light station, and has accepted the tender of Messrs. Meldrum Bros., Ltd., of Manchester, for a bridge across the river and a Meldrum simplex regenerative destructor.

Northern Hospital.—There was an error in one of the names printed in our last issue. For the firm rendered "C. W. Were & Co.," please read "C. M. Vere & Co.," whose address is 5, Park Parade, North Finchley, N.

Rochdale.—The Rochdale Electric Co., Ltd., has secured the contract for the complete equipment of electric motors for the new car-shed of the Corporation.

Stockport.—The Corporation Tramways Committee has accepted the following tender in connection with the electrification of the Hazel Grove route:—For the overhead equipment, Messrs. R. W. Blackwell & Co., London, for the sum of £4,343. For this work, 13 tenders were received. The accepted tender was the lowest, the next lowest, being that of the British Electric Co., for £4,683.

Sunderland.—The T.C. on the 8th inst. accepted the tender of Messrs. Balcke & Co., of London, for a cooling tower. The tender of the Sunderland Forge and Engineering Co., Ltd., was accepted for compounding the two Silvertown dynamos at Hylton Road station.

It was also resolved that the necessary machinery be obtained, and extensions of mains made for supplying electrical energy to Messrs. James Laing & Sons, Deptford, Sunderland, at an estimated cost of £5,050.

Swindon.—The T.C. has accepted the tender of Messrs. J. J. Horsfield & Co., of Dewsbury, for the supply of a Lancashire boiler for the Electricity Works, at £1,385.

FORTHCOMING EVENTS.

To-day's Arrangements.—At 7.30 p.m. N.E. Coast Institution of Engineers an Shipbuilders. Meeting.

At 8 p.m. The Electrical Engineer (R.E.) Volunteers. Bohemian Concert at the Horns Assembly Rooms, Kennington Road. Colone Crompton, C.B., will preside.

Monday, February 20th.—At 8 p.m. Society of Arts. "Internal Combustion Engines," by Mr. Dugald Clerk. (Lecture II.)

Tuesday, February 21st.—I.E.E. (Manchester). Paper by Messrs. H C. Gunton and S. L. Pearce on "Manchester Tramways Power Supply."

At 8 p.m. Institution of Civil Engineers. Next paper:—"Surface Condensing Plants, and the Value of the Vacuum Produced," by Mr. Richard W. Allen.

Thursday, February 23rd.—At 8 p.m. I.E.E. (London). "The Value of Overhead Mains for Electric Distribution in the United Kingdom," by Mr. G. L. Addenbrooke. (Continuation of discussion.)

At 8 p.m. Tramways and Light Railways Association. Mr. H. Jones on the "Waterloo and City Railway."

Leeds Association of Engineers. Mr. J. T. Pullon on "Some Notes on Prime Movers and Modern Power Generation."

Friday, February 24th.—At 5 p.m. Physical Society. Meeting at the Royal College of Science.

At 7.30 p.m. I.E.E. (Manchester Students). Mr. Buttenshaw on "Metallography."

At 8 p.m. Electro-Harmonic Society. Concert (Ladies' night) at King's Hall, Holborn Restaurant.

Saturday, February 25th.—Association of Engineers-in-Charge. Dance.

THE ELECTRICAL VOLUNTEERS.

The following orders are announced for next week:—

Monday, February 20.—"A" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Lecture on "Polyphase Alternating Current Machinery," by Lieut. T. Rich, 9 p.m.

Tuesday, February 21.—"B" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Medical inspection for recruits and Special Service Section, 7 p.m. Lecture on "Exceptional Electrical Devices," by Sergeant H. E. White.

Wednesday, February 22.—Instructional drill, headquarters, 8 p.m.; plain clothes; rifles without slings. Submarine mining class, 6–9 p.m. Examination "A" and "B" Companies for "A" badge, 7.30 p.m.

Thursday, February 23.—"C" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Lecture and demonstration on "High Tension Electrical Phenomena," by Capt. E. Russell-Clarke and Mr. Lucas, 8 p.m.

Friday, February 24.—"D" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Lecture and practical demonstration on "The Steam Engine," by Capt. Phillips, 6.30 p.m.

Saturday, February 25.—Week-end class.

J. H. S. Phillips, Captain,
For O.C.E.E.R.E. (V.)

NOTES.

The Proposed Electrical Exhibition.—In keeping with the announcement which we made in our last issue, a meeting of electrical manufacturing firms—called together by the National Association of Electrical Manufacturers—was held on Wednesday afternoon at the Hotel Cecil, for the purpose of considering the question of a proposed electrical exhibition to be held in London. From the course the discussion took, we gathered that the multiplication of small electrical exhibitions in different parts of the kingdom was becoming a very heavy burden to the manufacturer, and that one thoroughly good show on a large scale would be more acceptable to him. It was felt that the time was ripe for a large exhibition which should be representative of all branches of electric lighting, heating and power. From letters which were placed before the meeting, it was very clear that there is a willingness—we had almost said eagerness—on the part of a very large number of the principal electrical manufacturers throughout the country to support the undertaking as exhibitors. The meeting voted unanimously in favour of the scheme, and proceeded to elect an executive committee. This, it was agreed, should consist of 10 representatives from among the manufacturing interests (five firms on the Association's roll of membership, and five outside), four representatives from the electricity supply companies, and one from the electrical Press. A great many details were touched on briefly at the meeting, but they mainly related to matters which will rest with the executive committee for settlement. All we need say at the present juncture is that the exhibition promises to be larger than any that we have so far had in this country, that it will be held in the autumn in a central position in London, and that it has the promise of very substantial support.

British Electro-Therapeutic Society.—According to the *Lancet* the annual meeting of this society was held on January 27th, when the following were elected as officers for the ensuing year:—President: Dr. Donald Baynes. Vice-Presidents: Dr. Dawson F. D. Turner and Mr. Chisholm Williams. Council: Dr. J. Allan, Dr. D. Arthur, Dr. G. B. Batten, Dr. James Berry, Dr. J. A. Codd, Mr. R. H. Cooper, Mr. Hall-Edwards, Dr. G. H. Graham, Dr. W. S. Haughton, Dr. G. Herschell, Dr. J. Donald Pollock, Mr. A. D. Reid, Dr. S. Sloan, Dr. Septimus P. Sunderland, and Mr. C. A. J. Wright. Treasurer: Dr. H. McClure. Assistant treasurer: Dr. H. Lewis Jones. Honorary secretaries: Dr. H. E. Gamlen (West Hartlepool) and Dr. E. R. Morton (London). The annual address by Dr. J. Macintyre, of Glasgow, was read by the retiring president, Dr. H. Lewis Jones, Dr. Macintyre being unavoidably absent through illness. At the annual conversazione which followed, there was a full attendance of members.

The Junior Institution of Engineers. — The "Coming of age" dinner of this Institution took place on the 11th inst., Mr. W. H. Lindley, M.Inst.C.E, the President, being in the chair at the Hotel Cecil. After the customary loyal toasts, the humour of the evening was set going by Prof. Ayrton, who proposed the first toast of "Legislation and Engineering"; this was replied to by Mr. Balfour Browne, K.C., and Mr. James Swinburne. All three speeches were very funny. Something was said about the three-mile limit, and the fearful care given to the working-man in regard to providing him dwellings where he didn't wish to live, and, generally, the vagaries of the Legislature came in for chaff. Mr. Swinburne asked, as movement was relative, why should not beer, and the milk he himself drank, be pumped on Sunday three miles to the thirsty one, in place of compelling the thirsty one to struggle three miles in raising a thirst, all the bigger for the motor-polluted dusty road on which he must walk? Part of this is ours, not Mr. Swinburne's. Those who chose to do so might have read between the clouds of chaff, a good argument for amending both the Legislature and the Bar, through whose inattention to their guineas-marked briefs the ordinary civilian treads the thorny path of frightful expense if he desires to undertake anything industrial.

It then fell to the President to propose "The Port of London," and he used the opportunity to tell us how the old Hanseatic towns of North Germany once had a wharf on the Thames, where now stands Cannon Street Station, and how, that wharf being sold, Hamburg and Bremen and other places have extended their own ports, and canals have been constructed in Germany and in Belgium, and are still being constructed, while he might have added, those of England have been allowed to decay, or have been strangled into desuetude. This toast was responded to by the Venerable Archdeacon Sinclair, who made what we think is an error, in ascribing the shrinkage of the London clay, which has caused St. Paul's to settle, to the construction of the twopenny tube. This and the shrinkage are probably a coincidence only, for the drying of the London clay is probably caused by the lowering of the water level in the chalk beneath the clays to the horizon of the top of the chalk itself, by long years of artesian well pumping. The Archdeacon spoke instead of Mr. W. H. Grenfell, M.P., who was kept at home by a domestic incident that seemed to serve as a point for almost all subsequent speakers.

Everyone was agreed when Mr. P. I. Waldram, in proposing "Municipal Engineering Progress," suggested the benefit of fully published accounts and proper auditing of the same, so as to check the foolish and wasteful mismanagement of public affairs and public money by untrained men of no knowledge in the great affairs of which they are the absolute, but temporary and irresponsible rulers. The President replied to this, and tried to let them down easy, and laid stress on the good intentions which, he felt sure, animated all municipal men. Prof. Ewing talked to us of applied science, and Dr. Glazebrook responded in an excellent speech.

"The Senior Institutions" were given by Mr. Wells, Wh.Sc., and responded to by Mr. Chas. Hawksley, M.I.C.E., who told how Mr. F. Moulton had once to explain a lettered diagram to a Court, and began with the words, "This, my Lord, is a machine to blow a current of cold air through L." Mr. Siemens also replied with Mr. Hawksley. Lord Reay, G.C.S.I., &c., proposed "The Junior Institution," and Mr. Cutler, M.I.M.E., responded; after which "The President" was proposed by Mr. Hunter, A.M.I.C.E., and suitably acknowledged.

The evening was rendered particularly enjoyable by violin solos, and there were songs and sundry imitations. The excellent work of Mr. Dunn, the able and indefatigable secretary, was not forgotten, and everyone went home happy.

The Society of Architects.—A paper was down to be read before this society last evening by Mr. B. R. Tucker, on "The Lighting of Buildings by Electricity and Incandescent Gas."

Gas.—An Islington woman was suffocated by gas last week, a leaky pipe being the cause.

On 9th inst. a serious gas explosion occurred at the Central Railway Station, Glasgow, causing injuries to four men. A leaking pipe under one of the platforms, where the gas used for lighting the trains is stored, was the cause of the disaster.

Institution Notes.—The members of the Mining Institute of Scotland, on 8th inst., visited the works of Messrs. Mavor and Coulson, Ltd., of Mile End, Glasgow, and witnessed coal-cutting machines on test.

Tramways and Light Railways Association.—On the 8th inst. the members of this Association visited the power station of the London United Tramways Co. They were shown round by Mr. J. Clifton Robinson, who informed them that the company carried about 50 million passengers per annum, and employed 2,000 officials, a number which would be doubled when the extensions were completed. The company is spending £700,000 on the extension of its system to Merton, Tooting, Wimbledon and other neighbouring districts.

On the following day the ordinary general meeting of the Association took place, Mr. Alfred Baker, the President, being in the chair. Mr. Arthur Stanley, M.P., was elected President for the new year, and took the chair, while Messrs. H. England, J. B. Hamilton, J. H. Rider, S. Sellon, and Lord Vaux of Harrowden were elected to fill vacancies on the Council. The new President referred to the marked improvement in the attitude of local authorities towards tramway companies, and expressed his confidence in the future of tramways as opposed to motor-'buses. He said that a meeting had been arranged with the Association of Municipal Corporations, from which they hoped good results would ensue.

Fatalities.—The *Newcastle Daily Journal* says that a foreman electrical engineer, named Thomas Winsby, aged 25, employed by Messrs. Bolckow, Vaughan & Co., at Eston Jetty, Middlesbrough, was killed on Wednesday night last week. He, and a workman under him, named Jackson, were looking for a leakage under the electrical engine house, when Winsby, it is supposed, touched a live wire and fell over into a well below. He was at once got out, but death was found to have been instantaneous.

A wireman in the employ of the Electric Tramway department at Rochdale, while working at Healey, overbalanced himself in the act of pulling up a wire, and fell to the ground. His skull was fractured, and he died almost immediately.

On January 28th an electric pump driver, employed in No. 2 Tytrist Colliery, Tredegar, met his death through receiving an electric shock. At the inquest Mr. W. A. Scott (of the firm of Ernest Scott and Mountain, electrical engineers, Cardiff) said the primary cause of the accident, in his opinion, was the nipping of a fuse between the lid and the case of the cast-iron fuse box. His opinion was, that if the earthing had been effective, this accident would not have happened. It could have been improved and maintained by being more frequently tested—at least once a month. The jury returned a verdict of "Accidental death, by being electrocuted by coming in contact with a live current of electricity whilst in the performance of his duties."

Almost a Range-finder.—Writing to the *Morning Post* of February 13th, Mr. C. G. Hall describes a new use to which the prismatic compass has been applied—namely, the finding of a lost target. The high tides at Aldeburgh had carried it away and concealed it beneath immense masses of shingle. The area was mapped out into squares, each side of which was five paces, and readings were taken at each angle. The experiment was complicated by other masses of iron. No inference could be drawn from hundreds of readings taken upon two successive days, the reason being that the dulness prevented the observation of a sufficiently distant object. The third day was bright, but still no inference could be drawn. On the fourth day readings were taken with the compass as near as possible to the shingle, when the indications were decisive. A red flag was placed here, and a party of diggers soon afterwards found the target immediately beneath it.

Electro-Harmonic Society.—The next Concert, a ladies' night, is to be held at the King's Hall, Holborn Restaurant, on Friday, 24th inst., commencing at 8 p.m. Songs will be rendered by Miss Mabel Manson, Miss Carmen Hill and Mr. Arthur Strugnell; the programme also includes short stories by Mr. Earle Douglas, humorous sketches by Mr. Frank Leedham, and Mr. Walter Graham will perform as "The Human Marionette." The instrumental music includes a violin solo by Mr. T. E. Gatehouse.

Homopolar Dynamos.—An interesting letter on this subject has just come to hand, too late for inclusion in this issue. The subject is an attractive one, and, we think, well worthy of attention on the part of dynamo and motor designers.

Rugby Engineering Society.—At last night's meeting a lecture was to have been delivered by Mr. A. Churchill, on "Edison, and His Early Work."

Appointments Vacant.—Mains superintendent for Carlisle (£120); the G.W. Railway wants an electrical engineer for traction and lighting, at £600 per annum; switchboard attendant for Mexborough (£1).

Electricity in Mills.—On the 2nd inst. a discussion took place at the Dundee Institute of Engineers on this question. Mr. H. Richardson, the Corporation electrical engineer, made out a good case for electricity; he claimed for it reliability, steadiness, increased output, economy of capital cost, flexibility, &c., and stated that whilst the working costs of an up-to-date steam-driven mill were hard to beat, most of the mills in Dundee were equipped with very old engines and had high costs. The Corporation power station was not well situated for supplying the mills, but from a station in the proper place power could be supplied cheaply. The meeting showed little inclination to favour electric driving, and it was stated that the prices quoted by the proposed power supply company were out of the question.

An Australian Critic.—Mr. Kirkcaldie, one of the Railway Commissioners of New South Wales, has been interviewed by the local Press on his return from a tour in America and Europe, and has neatly summed up the traction situation in the effete countries named. His views are such as to indicate shrewdness and keenness of observation to a marked degree. While he saw little worth copying in New South Wales, he saw much to envy in the density of traffic, easy gradients, &c., which are wanting there. His criticism of American railway methods is anything but complimentary, and he holds up British practice as the standard of excellence. The signalling on the latter excited Mr. Kirkcaldie's admiration. Dealing with electric traction on railways, his view is clearly that the time is not yet, and he is content to wait and allow further developments to take place before attempting to introduce it in Australia. The steam omnibus made a very favourable impression on his mind, and the British double-decked tramcars met with his approval. On the whole, he considered that traction methods in vogue in New South Wales would compare not unfavourably with those in any other country that he had visited.

Royal Society.—The following papers were down for reading before a meeting held last evening:—Dr. C. G. Barkla, "Polarised Röntgen Radiation"; Communicated by Prof. J. J. Thomson, F.R.S. Prof. B. Hopkinson, "The Effects of Momentary Stresses in Metals"; Communicated by Prof. J. A. Ewing, F.R.S.

Armstrong College of Science.—The *Times* says that the King has consented to open, next year, the wing which will complete the college buildings.

Use of Coal.—Before the Society of Experimental Engineers at Dundee recently, a lecture on "The Economical Use of Coal" was delivered by Mr. Harry Richardson, the city electrical engineer, who dealt largely with the smoke nuisance. One of the chief causes of the smoke trouble, especially in the North Country, was the fact hatt bituminous coal was used, while unconsumed hydro-carbons, due to imperfect combustion, was also responsible for it. Where anthracite coal was used very much less trouble with smoke was experienced. In conclusion, he stated that investigation into the combustion question would repay care and trouble more than any other department of steam plant engineering.

A Belated Radiogram.—A gentleman who sailed for New York on Wednesday, February 1st, arranged to send a radiogram from mid-Atlantic and also to cable in the old-fashioned way on his arrival at New York. On Thursday morning, February 9th, a cablegram was received from him in the ordinary way per Western Union Telegraph Co. announcing the fact that he had arrived safely at his hotel in New York, and on Friday, February 10th, the radiogram came stumbling in undated, but signed by the gentleman in question as having been sent from mid-Atlantic, announcing that he was having a splendid passage and would arrive on Wednesday, the 8th inst.

Exactly what occurred to the radiogram is not known, but as it had the choice of proceeding from mid-Atlantic to the receiving station on these shores, either by the shortest route connecting these points, or by starting off in the opposite direction and going to infinity (where mathematicians tell us that plus and minus become somewhat mixed), and getting round to the receiving station by the back door, it is within the bounds of possibility that it may have chosen the latter route. There seems to be still some advantage in being able to coerce an electric impulse to follow the shortest distance between two points, and this has hitherto been fairly successfully achieved by means of a copper wire suitably insulated.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—Mr. E. F. COX, who for the past 2½ years has acted as chief assistant to Mr. Colson, of the Hamilton Electricity Supply Co., has been appointed burgh electrical engineer at Wishaw.

Mr. CHAS. W. SALT, of Croydon, has been selected for the post of second assistant engineer at the Bradford Corporation Electricity Works at an annual salary of £250.

Recently there has been considerable commotion among the electrical employés of the Wrexham Corporation, owing to an attack that was made upon the borough electrical engineer (Mr. J. SILLERY) by a member of the Council, based upon information supplied to him by one of the switchboard attendants. At a meeting of the full Council, sitting in Committee on January 2nd, which lasted for nearly four hours, the matter was exhaustively sifted, and the result was the complete exoneration of Mr. Sillery, to whom the Councillor, who had brought the question forward, tendered an ample apology. Subsequent to this meeting, however, the switchboard attendant informed the Councillor that he had discovered that the statements which led to the exoneration of his chief, were not true. Hence, another full meeting of the Council was held on Thursday, 9th inst., when there was another lengthy sitting. At this meeting Mr. Sillery made a statement to the effect that he was placed in responsible charge of the works, and the men under him should be under his authority; but if they were allowed to carry tales to individual members of the Council, with a view to undermining his authority, he was placed in a false position. He was quite prepared to refute all the false statements that had been made, and pointed out that the work of the Corporation was injuriously affected by the "tittle tattle" which some members of the Council had thought proper to listen to. The usual course in all public and private works of importance was, that any complaints of the workmen should be conveyed through the foreman to the superintendent, and that he should have full power to deal with the complaints made. He expected to be supported when performing his duties, and not harrassed by needless fault-finding. Had any member of the Council applied to him in reference to this matter, he could have given explanations which would have rendered the meetings of that Council unnecessary. After a lengthy, and at times acrimonious discussion, it was decided, by a majority, that Mr. Sillery had acted perfectly correctly, and that no blame attached to him in any way.

On February 11th, at the Brompton Oratory, by the Rev. Father Christie, RICHARD PAPE, municipal electrical engineer of Port Elizabeth, was married to Margaret Hunt, youngest daughter of Anthony Hunt, of Bare, Morecambe.

Mr. WITHYCOMBE, superintendent of the overhead equipment of the West Ham municipal tramways, has been absent from his duties since Christmas owing to illness. Recently he had to undergo a serious operation. On Tuesday the Corporation expressed sympathy with Mr. Withycombe, and granted him six weeks' leave of absence.

Tramway Officials.—On Monday last week, at St. Paul's Church, Southport, Mr. JAMES ALFRED ROPER, chief inspector of the Sheffield Corporation Tramways, was married to Miss Gunson.

A Dundee paper says that Mr. JOHN JOHNSTONE, formerly of P. & J. Johnstone, has been appointed superintendent of the Muskgoee Electric Traction Co., of Muskgoee, Ind. Terr., U.S.A.

A silver watch has been presented to Mr. J. REDRUP by the staff and employés of the Kidderminster and Stourbridge Tramway Co., with which he has been for 3½ years as traffic superintendent, on his departure to take up the position of traffic manager to the South Staffs. (Lessees) Tramway Co.

General.—The first annual dinner in connection with the Blackburn District male staff of the National Telephone Co., Ltd., was held last Saturday evening at the Golden Lion Hotel, Blackburn, representatives of all departments being present. The district manager, Mr. C. REMINGTON, M.I.E.E, occupied the chair, and was supported by Messrs. Stevenson and Frost (Blackburn), and Mr. Callis (Burnley). In proposing the toast of the company, the chairman said he was glad to see all grades of the company's staff present, and trusted that the inaugural dinner would develop into an annual function, as he felt sure that such social gatherings fostered a feeling of goodwill. A musical programme, arranged by Mr. C. Etheringion, followed.

We read in *Indian Engineering* that Mr. W. J. BIRNIE, who, on return from leave, has resumed his duties as resident electrical engineer under the P. and O. Steam Navigation Co., has been appointed, with the consent of his employers, inspector of electric installation for the Island of Bombay, in place of Mr. F. Hersee, for the purpose of carrying out the duties contemplated by the Indian Electricity Act, III of 1903.

In our "Trade Announcements" this week we mention the change of address of Mr. THOMAS BROWETT, who has been appointed general manager of the Diesel Engine Co. It is somewhat significant that an engineer so well known in steam engineering circles should thus transfer his energies to the cause of the internal combustion engine. His appointment can scarcely fail to be of material advantage to his new employers, and we wish him all success in his new position.

Mr. C. E. VORMEISTER, A.M.I.E.E., has resigned the post of mains superintendent to the Carlisle Corporation Electricity Works. He is starting an electrical business in Carlisle, and his address will be Lowther Arcade Chambers, Carlisle.

Obituary.—It is with deep regret that we record the death of Mr. C. J. SUTHERLAND, M.I.E.E., late city electrical engineer of Worcester, which occurred on January 30th, the burial taking place at Astwood Cemetery, Worcester, on February 2nd. For some years past Mr. Sutherland had suffered from ill-health, and he has finished his work at a very early age, being only 33. He designed and carried out at Worcester the erection of the Hylton Road station of 810 KW. capacity for three-wire low tension continuous current lighting and traction supply. He was very much respected by his staff, every available member of which attended the funeral, and floral tributes were sent from both stations. Mr. Parker (chairman of the Electricity Committee) and Corporation officials also attended the ceremony. The deceased gentleman has left a widow and one little son to mourn his loss.

CITY NOTES.

Marconi's Wireless Telegraph Co.

THE annual report and statement of accounts for the year ending September 30th last have been issued by the directors. The balance-sheet shows that 221,127 shares have been issued, and are fully paid except for £50 5s. calls unpaid making the paid share capital £221,076 15s. The amount of expenditure in establishing the business in excess of the receipts to September 30th, 1903 (£21,850 7s. 6d.) has been deducted from the share premium account (£47,810), leaving a balance of £25,956 12s. 6d. Creditors amount to £23,475 7s. 2d., and the balance from profit and loss account is £12,681 5s. 3d. The assets are shares in associated companies (acquired by agreement) of large nominal value reduced by a reserve to £63,745 17s. 4d.; similar shares purchased and taken at cost, £29,185 2s. 4d.; patents stand at £80,589 18s. 7d.; plant, machinery and buildings, £33,106 6s. 7d.; furniture, £318 14s. 1d.; stock, £14,924 15s. 8d.; debtors, £36,430 7s. 3d.; cash and loans, £6,009 17s. 7d.; and amounts due from associated companies, £18,882 0s. 6d.

The profit and loss account shows that the gross profit was £33,289 9s 11d.; other sources of income were transfer fees, £109 15s. 7d.; and interest and discount, £720 4s. 5d. The total of £34,119 9s. 11d. is reduced to a net profit of £12,681 5s. 3d. by expenditures as follows:—Directors' fees and salaries, £5,389 16s. 4d.; law charges, professional fees, patent fees and expenses, £5,683 13s. 1d.; travelling expenses, rents, rates and taxes and sundries, £9,304 7s. 4d.; and repairs, renewals, and depreciation, £1,060 7s. 11d.

In their report the directors remark that the profit of £12,681 5s. 3d. compares with £10,607 7s. 8d. for the previous year. They

consider that the company is now in possession of all the data necessary for the equipment of stations for good commercial working between England and America, and a new station, fully equipped, is nearly completed in Canada. The greater part of the machinery for a similar station in Great Britain has been ordered, but the site for such station has not yet been selected. The new agreement with the Post Office came into operation on January 1st. Orders have been received from the Admiralty. Four stations have been equipped on the St. Lawrence, and a new contract entered into with the Canadian Government representing extensions of stations for that Government. Five stations have been equipped along the Labrador coast. The stations for a service between Italy and Montenegro are now in operation for commercial purposes, and a number of new stations in Italy have been completed. The use of wireless stations for Press messages between England and Amsterdam is under consideration by the Post Office. The Government of Chili is discussing the application of the system after successful demonstrations. A contract has been entered into with the War Office for communication between certain of the Channel Islands. On the subject of the Berlin Conference, the directors say that they feel the company has, in the contracts which it has secured, protection against decisions of the Conference injurious to the international service which has been organised. The Meteorological Office is in communication with the company with a view to arranging for a service of weather reports similar to those already published by the *Daily Telegraph*. The works have been so fully occupied that the directors are taking steps to provide new works affording opportunity for extensions. The international organisation of ship and shore stations has been very greatly extended. Sixty shore stations are now available, and a list of vessels, equipped with Marconi apparatus, is given in the report. 30,000 shares at par have been "placed" through the assistance of a "group," in which six of the directors were, directly or indirectly, interested, the consideration for the group's guarantee being an option to take up a further 30,000 shares at 27s. 6d.

It will be noted that whilst the shares of associated companies are valued at £92,930 19s. 8d. in the balance-sheet, there is also an entry showing that the same companies owe £18,882 0s. 6d. The question of adequate depreciation is necessarily a difficult one, but the amount of £1,060 7s. 11d. to cover repairs, renewals, *and* depreciation on plant, machinery and furniture valued at £33,425 0s. 8d., seems small when the nature of the plant and its rapid improvement are taken into account. When directors undertake to place shares at par in consideration of an option to take a similar amount at a premium of 7s. 6d., it suggests the expectation that an increased value in the shares may be looked for, but it is not quite clear why those directors should not have secured the par shares and omitted the premium option. As will have been seen from our summary of the report, the Marconi Co. are able to report an increased use of their apparatus in the sphere in which it does not come into competition with existing telegraphic facilities, and it is the more to be regretted that the only estimate of future profit is that relating to trans-Atlantic communication. The estimate assumes an earning, after deducting land charges, of £56,000 per annum on the basis of the transmission of 15 words per minute for 10 hours a day for 300 days in the year, the rate being 6d. per word. We should have preferred to see an estimate of earnings within the sphere of operations in which the value of wireless telegraphy has been proved, and we cannot but consider it unfortunate that the shareholders should have placed before them an elaborate estimate of problematical earnings in long-distance transmission where the efficacy of the wireless system has not been proved, and where efficient alternatives exist. Why do the directors seek to incur a considerable outlay for the purpose of entering a competitive field, when so many openings exist for non-competitive business that may be obtained for smaller outlays?

London Electric Supply Corporation.

In our issue of February 3rd (p. 196) we announced that this company had at last, owing to the improvement in business during 1904—chiefly owing to the demand for energy for the L.C.C. tramways—been able to propose a dividend for the ordinary shareholders. The exceedingly difficult times which the company passed through in its early days are, we suppose, quite unknown to very many men who are connected with the electrical industry to-day, but those who are interested in the matter, and are so fortunate as to have access to files of the Electrical Review for, say, 12 to 15 years ago, will be able to read of the anxieties which were then passed through, anxieties both engineering and financial in description. But the troubles did not end 12 years ago; they have been recurring almost continuously, only in different forms, year after year. The self-sacrificing part played by the late Lord Wantage, in standing by the concern so manfully, occurs to our mind as calling for a passing mention now that it has been possible to show a return on the ordinary capital. The company was undoubtedly a pioneering one. It was registered as long ago as 1887 under its present title, but, as a matter of fact, it had an existence under another name two years before that date. Of the original directors and officials associated only three now remain, these being Lord Crawford, Mr. R. Stewart Bain (the present managing director) and Mr. Partridge (the chief engineer). Of course, it must be recognised that the results for last year—an increase from 4 millions to 10½ millions units sold—are chiefly consequent upon the tramway demand. At last year's annual meeting the chairman (Mr. R. H. Benson), in a carefully worded speech, placed the estimate at from 8 to 10 millions for the year, and at the forthcoming meeting he will be able to tell shareholders that the result has been even better than his forecast. If he could also tell the meeting that the L.C.C. would be needing an equally large quantity of energy for a couple of years or so longer, the shareholders would feel that the company had reached a permanent dividend-paying stage.

The report shows that the profit on working (adding £2,137 for interest and balance brought forward) is £67,470. Interest charges of £15,478 are deducted, leaving £51,992, which is to be dealt with thus:—

6 per cent. dividend on the preference shares ...	£16,452
3 per cent. dividend on the ordinary shares ...	9,990
Reserve (making a total of £25,000)	18,540
Provision for contingencies	5,000
Carried forward	2,010
	£51,992

The supply of current for power and lighting has been efficiently maintained, and the anticipation stated in last year's report regarding decrease in cost of production has been more than fulfilled.

The units sold were 10,531,785 as compared with 4,102,099 during 1903. It would be interesting to know how much was for traction and how much for ordinary purposes. The expansion in the business required a capital expenditure of £49,378 during the year. The plant and machinery have been maintained out of revenue, and are in efficient condition.

St. James' and Pall Mall Electric Light Co.

The ordinary general meeting of the shareholders of this company was held on Tuesday, at the offices, Carnaby Street, Golden Square, Col. Eustace J. A. Balfour presiding.

The Chairman, in proposing the adoption of the report, said that for the eighth year in succession they were able to make a distribution at the rate of 14½ per cent. on the ordinary shares. The present position of the company was, he thought, perfectly satisfactory. Last year when addressing them he was at some pains to explain what at first sight appeared to be a set back in the progress of the business. He pointed out then that the comparison of that year's working was made with one of quite exceptional prosperity, in which the Coronation led to unusual activity which had a material effect upon their business. Further than that, whilst they were passing through a period of trade depression, their own costs were unduly enhanced by the interest charges of capital in the Central Co. during the period of construction of that company's important works. In the result they had to have recourse to the contingency fund, which they had specially provided for that emergency, and one-half of the sum was used, the balance being held in reserve for 1904 if required. He was able, however, to re-assure them on all those points, and he was sanguine that their position would be improved. The accounts before them showed that in the past year they had done even better than they expected. The Central Co. had declared a dividend of 5 per cent. on its share capital, of which they held one-half, so that not only had they not had to draw anything from the contingency fund, but that dividend of £2,500 received since the closing of the accounts would enable them this year to restore that fund to its original amount. In other words, 1904 had proved about £5,000 better than 1903. Further, the Central Co., having commenced the year by charging them 2d. per unit, was able, after paying all expenses, including proper provision for depreciation, to amend its charge on the whole of its output for the year to 1⅞d. per unit, and there was reason to believe that on the current year it would be able to do better still. That was a matter which was of vital importance to them. Their own capital was stationary, and they had no large expenditure in contemplation. Any future increase of supplies for their business would be drawn from the Central Co., and therefore the price at which they could deliver a unit of electricity to consumers would depend more and more largely each year on the price at which the Central Co. could generate it. For the past year they had been well satisfied. The supply had been furnished them in a most regular manner, and the charge was below that which they had anticipated. He was glad to be able to tell them that their own business had made steady progress. They had added during the year the equivalent of 24,421 8-c p. lamps, making a total at the end of the year of 278,889. The output for the year amounted to 7,660,587 units, which was an increase of 520,382 units over the preceding year. They would see from the engineer's figures that 5,488,589 units were generated at the company's station, and 2,088,347 units were purchased from the Central Co. They had been enabled to make substantial reductions to their customers, and it was the settled policy of the board to

make the service cheap as well as efficient, so as to establish the business on the widest possible basis. The company's works within the district had been fully maintained and were in first-class order. At the Carnaby Street station an artesian well had been sunk, from which the whole of the water required for the steam generating purposes was easily obtained. The position of the Central Co. furnished them with a reserve which enabled them to take up promptly any new business that might present itself. Certain Bills had been promoted in the ensuing session of Parliament, which might affect the interests of the company, and the directors had taken the proper steps to safeguard those interests.

Mr. Walter Leaf seconded the motion, and the report was adopted.

The Yorkshire Electric Power Co.

The directors report that since the meeting held in August, 1904, the buildings for the Thornhill power station have been completed, and, with the exception of the turbo-generators, all the plant has been delivered and installed. The first two of the turbo-generators are now being tested at the makers' works at Rugby, and it is anticipated that they will be erected in the station during the month of February. A supply of electricity was available at the works before the end of December, and the first consumer was connected on January 21st, 1905.

A general scheme of transmission has been decided upon, and plans have been prepared and apparatus ordered for a number of sub-stations. The laying of mains is being rapidly proceeded with, so as to give an early supply in Birkenshaw, Drighlington, Gomersal, Liversedge, Mirfield, Pudsey, Ravensthorpe, Thornhill, and other districts. At December 31st last 50 miles of cable had been ordered, of which 26 miles were actually laid. In addition to the agreement with the U.D.C. of Mirfield, reported at the last meeting, agreements have been entered into with the Corporation of Pudsey and the U.D.C. of Liversedge for a supply in bulk, the agreement with the latter, as with the Mirfield Council, enabling the company to supply large power users direct. Negotiations are proceeding with other local authorities, and agreements have been made with several large users of energy for power purposes in the districts in which mains have been already laid. Judging from the various applications made to Parliament and the Board of Trade by local authorities, companies and others, continued activity is being shown in the use and development of electrical energy. Those applications which refer to the company's area are having careful consideration.

The half-yearly meeting is to be held at Leeds on February 28th.

Bristol Tramways and Carriage Co.

The directors' report for the year ending December 31st, 1904, says that the gross receipts amounted to £259,800, and the working and general expenses and renewals are £168,799, leaving a net revenue of £91,001.

There has already been distributed interest on 4 per cent. mortgage debenture stock and deposits, £11,016; dividend on 4 per cent. preference shares, £19,021; interim dividend at the rate of 8½ per cent. per annum (subject to income-tax), for the half-year ending June 30th, £20,231—£50,668. It is proposed to appropriate the balance as follows:—Final dividend for half-year at the rate of 9½ per cent. per annum (subject to income-tax), £22,563; addition to reserve for contingencies fund, £17,770—£40,333—£91,001. The company's investments have been increased by £23,768 during the past year, and with the addition now proposed will be further augmented to £153,672. The receipts from the tramways department show an increase of £3,441. The total number of passengers carried during the year on the company's cars and omnibuses was 45,312,373, an increase of 920,934. The company obtained their Act of Parliament last session authorising the extensions of about 10 miles of route, including the principal roads out of the city, Parliament having approved the company's proposals that as to about nine miles the concession should be for at least 42 years, and the consideration, on any purchase by the local authorities after that period, fair market value as a going concern. The Act also confirmed arrangements with the various local authorities of Horfield, Kingswood, Hanham and Brislington, by which a fresh period of 42 years together with going concern terms of purchase were made applicable to all existing lines within those districts. The directors have to record with regret the death in December last of their esteemed colleague, Mr. William Franklin. Mr. James Henry Howell, J.P., has been elected by the directors to fill the vacant position.

Great Northern and Piccadilly Railway Co.

The half-yearly meeting of this company was held on Tuesday last at Hamilton House, Victoria Embankment, E.C., Sir Henry Fowler, G.C.S.I., M.P., in the chair.

In moving the adoption of the report and accounts, the Chairman said that the story of the company for the half-year was a very simple one, and could be told in one sentence. During the half-year the capital expenditure had been £644,896 17s. 3d., the majority of which had been expended in construction—nearly £631,000. The engineer's reports showed that the work had proceeded rapidly and satisfactorily. He did not think that it was possible for the work to be proceeded with more rapidly. At the next half-yearly meeting he hoped to be able to give some idea of when the work would be completed. A dividend of 4 per cent. per annum was proposed.

Mr. Lesley C. Probyn seconded the motion, which was carried.

Sir Henry Fowler was re-elected chairman, and Mr. Vivian H. Smith a director.

Messrs. W. B. Peet & Co., the auditors, were re-elected, and this concluded the proceedings of the ordinary meeting.

The meeting was then made "extraordinary," to consider the two Bills which the company are bringing before Parliament.

The Chairman explained that the first Bill was a formal one which sought to confer further powers on the company, while the second Bill was to empower the company to construct new railways in extension of their authorised railways and for certain other purposes. He formally moved that the two Bills be approved.

This was seconded by Mr. Probyn and carried.

The proceedings then terminated.

Northampton Electric Light and Power Co.

The report for 1904 states that the lamps and motors connected during the year were 6,576 (equiv. of 8 c.p. lamps), making a total of 47,431 of 8 c.p. The motors have increased from 251½ to 351½ h.p. Of these, 210 h.p. are hired out by the company. The separate consumers have increased from 704 to 801.

Distributing mains have been laid to the extent of 1 m. 1,262 yd., bringing the total up to 14 m. 1,575 yd. The extension to Dallington has been fully justified by the results. In the early part of the year the nominal share capital was increased from £50,000 to £100,000. Recently proposals were laid before the shareholders, and were unanimously adopted at the various meetings held in reference to the matter, for rearranging the share capital by obtaining surrenders of the "founders' rights," and of the special privileges attaching to the 6 per cent. preference shares. There are now two classes of shares only—namely, ordinary and 5 per cent. cumulative preference. The annexed accounts deal with the old order of things, the new arrangement coming into force on January 1st. As soon as there is a sufficiency of spare revenue, the extra dividends, or compensation, will be paid, but this can hardly be fully effected during the present year. Substantial additions have been made to the plant. The provisional order extending the area of supply to the whole of the county borough, as now constituted, and to various parishes, was duly passed. The Town Council offered £100,000 for the company's undertaking, the price they were advised by their own expert to offer, having been (it is generally understood) £120,000. Payment was to be deferred, and there were other impracticable conditions. The directors did not feel called upon to convene a meeting to consider these proposals. A further sum of £1,750 is now added to the depreciation fund, besides £50 written off motors. A certain amount of old plant has been sold, and the loss has been written off. The accounts show £1,746 available for dividends. It is proposed to pay a dividend at the rate of 5½ per cent. per annum for the half-year on the ordinary shares, making, with the interim dividend, 5 per cent. for the year. This will leave £816 to be carried forward. The directors are now prepared to allot 1,170 5 per cent. preference shares at 1s. 6d. premium per share, also 5,000 ordinary shares, at a premium, by way of tender.

The dividend for 1903 was 4½ per cent.

Chelsea Electricity Supply Co.

The directors report that the profit for the year ended December 31st, 1904, amounted to £35,063, which, with £1,200 brought forward, makes a total of £36,263.

After deducting interest on debenture stock, £7,188; balance of other interest, £67; interim dividend, 6 per cent. on preference shares, £900; interim dividend on ordinary shares at the rate of 4½ per cent. per annum, £4,999; amount written off suspense account, £2,363 = £15,517, there remains a balance of £20,746, which is to be appropriated as follows:—

To credit of renewals and depreciation fund	£10,344
To final dividend on the preference shares at the rate of 6 per cent. per annum, making 6 per cent. for the year	900
To final dividend on the ordinary shares at the rate of 7½ per cent. per annum, making 6 per cent. for the year	8,332
Leaving a balance to be carried to the next account of	1,170
	£20,746

A further expenditure, amounting to £3,875, has been incurred during the year in connection with changing the system of supply from 100 volts pressure to 200 volts. This amount has been added to the suspense account, from which £2 363 has been written off, leaving that account at £4,725. The number of lamps connected on December 31st, 1904, was 210,659, an addition of 15,424 during the year, and the improvement in the units sold per lamp continues. The total number of units sold in 1904 was 3,212,412, being 473,060 more than the previous year. During the year an issue of £25,000 debenture stock was made at the price of £107 10s., and the net premiums, amounting to £1,664 14s. 10d, have been carried to debenture stock premium redemption fund. The directors have to record, with great regret, the loss of their esteemed colleague, Major-General C. E. Webber, C.B, who was one of the first directors of the company. The directors do not propose that the vacancy should be filled.

The meeting is to be held at Winchester House, E.C, on Wednesday, February 22nd.

Cambridge Electric Supply Co.

The directors report that the progress of the company during 1904 has continued to be satisfactory.

During the year a further call has been made of £1 per share yielding £9,423 and £80,000 of 4½ per cent. debentures have been issued at par to the shareholders. £25,000 of this debenture issue has been paid up. In order to meet the increasing demand for electrical energy a large extension has been made to the works and additional plant and machinery have been ordered, of which part is already delivered and at work. The property in Thompson's Lane referred to in the last report has been fitted up as stores and workshops. Additional property immediately adjoining the works on the north side has been acquired to a portion of which, after alteration and extension, the offices of the company will be transferred. The remaining portion of this property and the space occupied by the present offices will then be available for further extension of the works.

A new scale of charges for electrical energy at reduced rates came into force on July 1st, and the directors hope for an increase in the demand as a result. During the year the equivalent of 3,074 8-c.p. lamps were added to the mains, making a total to date of 47,112. The units supplied were 523,298, an increase of over 51,000 units. After paying all charges, and placing £1,000 to depreciation the accounts show a balance of £6,692, which, added to £1,342 brought forward from last year, makes £8,034. An interim dividend of 2½ per cent. (£1,903) has already been paid, and the directors recommend a dividend of 4½ per cent., making 7 per cent. for the year. [The same as for 1903.] This will absorb £3,959, leaving a balance to carry forward, subject to fractional adjustment of income-tax, of £1,717.

The meeting is to be held at Cambridge on Wednesday, February 22nd.

Baker Street and Waterloo Railway Co.

THE report for the half-year ended December 31st last, submitted to the meeting held yesterday, states that capital expenditure during the half-year amounted to £173,133. For the current half-year the estimated expenditure is £600,000.

Satisfactory progress is being made with the works between the Elephant and Castle and Baker Street. The running tunnels have been driven throughout. All the station tunnels are through, except the down tunnel at the Elephant and Castle. All the lift and stairway shafts have been sunk except the lift shafts at the Elephant and Castle and the stairway shaft at Westminster Bridge Road. The passages giving communication with the platforms are all constructed except at the Elephant and Castle Station. Half the permanent way has been laid. On the Paddington section the running tunnels have been driven as far as Harewood Avenue and the permanent way laid. Possession of the land for the Edgware Road and Lisson Grove Stations was given to the contractors in June last. At Edgware Road a 23-ft. lift shaft and the stair shaft have been sunk, and the down line station tunnel has been commenced. At Lisson Grove the site has been cleared, and the underpinning of the adjacent property is in hand. Arrangements for the interchange subway with the Marylebone Station of the Great Cental Co. have been made. The company is promoting a Bill in Parliament to obtain power to make certain alterations in the subways at Trafalgar Square and the Elephant and Castle, to extend the time for the completion of the works and purchase of lands; also for power to issue debenture stock certificates to bearer.

Company Law.

WE are glad to note that the President of the Board of Trade has appointed a Committee to inquire into what amendments may be necessary in the Acts relating to Joint Stock Companies. The questions to which special attention is to be directed are:—

1. The growing practice of issuing companies without a prospectus.
2. The registration outside England of companies carrying on business in England and appealing to English investors.
3. The extension of the provisions of the Act of 1900 with regard to the registration of mortgages and charges to include all mortgages and charges, and not only those created since January 1st, 1901.
4. The amendment of Table A of the Act of 1862.

The members of the Committee are:—

Sir Robert T. Reid, G.C.M.G., K.C., M.P., Chairman.
Mr. J. W. Budd (ex-President of the Incorporated Law Society).
Mr. Frank Gore-Browne, K.C.
Mr. E. B. Faber, M.P. (Chairman, English Country Bankers' Association).
Mr. J. K. J. Hichens (Chairman of the Stock Exchange Committee).
Sir William H. Holland, M.P. (President of the Association of Chambers of Commerce of the United Kingdom).
Mr. F. B. Palmer.
Mr. Edgar Speyer.
Mr. C. M. Warmington, K.C.
Mr. Edwin Waterhouse (ex-President of the Institute of Chartered Accountants).
Mr. L. Worthington Evans, and
Mr. G. S. Barnes (Comptroller of the Companies Department of the Board of Trade).
Mr. H. A. Payne is to act as secretary.

Kensington and Knightsbridge Electric Lighting Co.

THE directors state that during the year the number of houses and shops connected with the system increased from 3,210 to 3,451, while the number of lamps, calculated on the usual basis of 8 C.P., increased from 280,133 to 303,048. The renewal account now stands at £55,932 9s. 8d., being an increase of £5,502 8s. over the amount of the account at the end of the previous year.

After providing for the amount placed to renewal account, writing £3,000 off cost of purchase of Kensington Court Co., Ltd., in the capital account, and after paying the dividends on the 6 per cent. first preference shares to June 30th, 1904, on the 5 per cent. second preference shares to September 30th, 1904, and an interim dividend at the rate of 10 per cent. per annum on the ordinary shares for the first half of the year, the balance standing to the credit of the net revenue account for the year 1904 is £18,659. Of the above sum, £1,500 has been appropriated to the payment of the first preference dividend to the end of the year, and £625 has to be set aside to meet the portion of the dividend on the second preference shares accrued to the same date. It is proposed to pay out of the balance of £16,534 a further dividend on the ordinary shares at the rate of 10 per cent. per annum for the past half-year, and a bonus of 2 per cent. for the year, making, with the interim dividend paid on August 1st, 12 per cent. for the year. This will leave a balance of £1,984 to be carried forward. During the year substantial reductions have been made in the charge for supply, representing a considerable saving to the consumers.

Charing Cross and Strand Electricity Supply Corporation.

THE report of the directors for the year ended December 31st, 1904, shows satisfactory results of the business done in both their West End and City areas of supply.

West End Undertakings.—**A new sub-station has been built in the Green Park, under agreement with His Majesty's Office of Works, for the purpose of supplying the public lamps in the Mall and parks, the Queen Victoria Memorial, and for other purposes. The lamps added during the past year have been 73,722 8-C.P., an increase of nearly 25 per cent. on the highest number previously obtained in the West End areas in any year. The total number now being supplied in the West End is 409,663. The total mains now laid amount to 325 miles. The regulations of the London County Council require all theatres to be furnished with supplies from two separate sources. The dual or alternative supply which was provided by the directors, under the advice of their engineer, has now been approved as complying with these regulations. The revenue from sales of current for 1904 amounts to £122,877 11s. 6d., as against £110,083 12s. 2d. in 1903. The balance of net revenue account is £55,942 3s. 9d., which it is proposed to deal with as follows:—Dividend on the 4½ per cent. preference shares, £17,719; dividend on the ordinary shares at the rate of 8 per cent. for the year 1904, £28,000; carrying forward £10,223 = £55,942.**

The City Undertaking.—**The erection of the first half of the generating station at Bow, which will hold plant of sufficient capacity to supply the equivalent of 800,000 8-C.P. lamps connected, is now completed, and contains plant to supply 600,000 lamps. Further plant, of the capacity of 200,000 lamps, will shortly be delivered. The four sub-station buildings in the city are now completed, and contain large storage batteries and plant of sufficient capacity to supply 450,000 8-C.P. lamps connected. There is ample space to more than treble this capacity, with practically no additional expenditure on buildings. Mains have been laid in all the principal and most of the secondary streets in the city. These are of sufficient capacity to supply upwards of 500,000 8-C.P. lamps Spare ways have also been provided into which extra mains, capable of increasing the supply to 1,000,000 lamps, can be drawn. There are 265 miles of mains now laid. There have been added during the year the equivalent of 58,968 8-C.P. lamps, bringing up the total now supplied to 301,081. The gross revenue from sales of current during the year amounted to £78,431 2s. 1d., or £22,394 13s. 2d. in excess of 1903. The net revenue account shows a profit of £15,670, which has been applied towards the payment of the 4½ per cent. preference share dividends to December 31st, 1904, and the balance of such dividends has been provided under the guarantee of the West-end undertakings.**

General.—**The engineer-in-chief certifies that the plant and machinery have been maintained in a high state of efficiency. The directors have thought it advisable, to enable the corporation to comply with the increasing demand for electrical energy for railway, tramway and other motive power purposes, to apply to Parliament for an extension of the areas of supply and further powers. It will be in the recollection of the shareholders that the Charing Cross and City Electric Co., Ltd., was formed under the authority of resolutions of this company for the purpose of contracting for and carrying out the works in the City of London. These works are now practically completed, and the directors are proposing to close all accounts between the two companies. Agreements for this purpose have been prepared and will be submitted to the shareholders for confirmation.**

	City undertaking.	West End undertakings.
Quantity generated or bought in B.O.T. units ..	10,503,473	12,090,377
Quantity sold—		
Public lamps	—	385,254
Other sales	7,351,737	8,218,795
Total sold	7,351,737	8,604,149
Quantity used on works.	2,973,474	3,267,247
Total quantity accounted for	10,325,211	11,871,396
Quantity not accounted for	178,262	218,981
Number of public lamps	—	178
Total maximum supply demanded KW.	7,240	4,900

WM. HY. PATCHELL, *Engineer-in-Chief.*

The 1903 dividend on the ordinary shares was 8 per cent.

Liverpool Overhead Railway Co.

THE thirty-third half-yearly general meeting of shareholders in the Liverpool Overhead Railway Co. was held on February 14th, at the Law Association Rooms, Cook Street, Sir William Forwood, chairman of directors, presiding over a good attendance.

The CHAIRMAN, in moving the adoption of the report and accounts, regretted that they were not more satisfactory. They had, for the first time, to record a reduction in traffic, partly due to the quiet state of trade during the early part of the half-year, but mainly caused by the competition of the frequent and rapid service of trains on the Liverpool and Southport line since its electrification. This falling off in traffic had taken place notwithstanding the reductions which had been made in the fares to meet competition. They had carried during the half-year 5,613,752 passengers, against 5,896 503 in the same half-year of 1903—a reduction of 282,751, or 4·8 per cent. Their gross earnings had been £41,488, against £44,110—a decrease of £2,622, or 5·1 per cent. But they had been able to meet that falling off in traffic by some reduction in expenses. They spent last half-year £29,530, against £31,210 in the corresponding half of last year—a saving of £1,680, or 5·3 per cent. The net income for the half-year was £12,187, against £12,935—a decrease of £748. The balance available for dividend, including £4,052 brought forward, was £10,134. Out of this the directors recommended the payment of the preference dividend of 5 per cent., which will absorb £3,266 14s. 3d., and the payment of a dividend on the ordinary shares at the rate of 1½ per cent. per annum, which will require £3,125, leaving a balance to be carried forward of £3,743. During the half-year they had earned 1·90d. per passenger. Their highest earnings were 1·99d. in 1897. The decrease was due to the reductions made in fares, particularly to working men. Their ratio of expenditure to revenue was 76·77, against 76·91. Their lowest ratio was in 1899, when it reached 58·60, thus proving that their accelerated service had not produced the increase in traffic they hoped for. Their revenue per train-mile had increased since the acceleration from 20·54d. to 22·78d., and their expenditure was 17·10d. against 18·43d. They could not do much more in the way of economy in working, as the expenditure they could control was really very small. They had received many letters from anxious shareholders making suggestions for increasing their earnings by reducing the fares, introducing differential booking, and granting contract tickets. All these letters and suggestions had been most carefully considered. Penny fares were, no doubt, popular, and where, as in the case of tramways, there was a large short pick-up traffic, they were profitable; but they must not forget that the tramways paid no rates, and had no costly structure. Feeling the competition of the Lancashire and Yorkshire Railway at the north end very keenly, they had endeavoured to win back their working men by giving them sectional 2d. return fares. The net result had been that they had carried 40,000 more passengers, at a profit of £99, equal to ·59d. per passenger; but the same increase

under the old rate would have shown a profit of £150. Differential fares would be introduced as soon as they made their connection with the Lancashire and Yorkshire system. Looking back upon the history of the company, which was opened for traffic in 1893, they found they had encountered a series of difficulties which could not be anticipated or provided for. They were very successful up to 1899; their dividend in that year reached 3 per cent. Then the Liverpool tramway system began gradually to be extended, and now competed with them at many points. The establishment of the telephone had also interfered with the growth of their traffic by doing away with the necessity of shipowners and their clerks visiting the docks as frequently as formerly. The trade of the port was also now worked with fewer men, owing to the large steamers employed. The directors had endeavoured to combat all these difficulties, and if they had not looked ahead, their position to-day would have been much less favourable than it was. The line was rendering a great service to the trade of the port, and they certainly deserved a larger share of public support than they were receiving.

Mr. Richard Hobson seconded the motion.

Mr. W. P. Thompson said, after the speech of the chairman, he no longer wanted to pass a vote of censure on the directors. Unless, however, the growing decrease in the traffic was stopped, matters would become serious for the company. The most successful line in the kingdom of that nature, he should say from all accounts, was the Glasgow tramways, which had ½d. fares as well as 1d. fares. By a sectional system with 1d. fares, he was of opinion that the Overhead Railway would be able to materially increase its traffic.

A Shareholder suggested that the directors' fees might be reduced for the time being until the company became prosperous. He also considered that a 2d. return ticket, as well as the issuing of contracts, would prove successful.

The Chairman, in reply, said it would be impossible to go down to a 1d. fare at present. It would mean that they would have to double the existing traffic, and it was not there to double. They dared not make bold experiments.

The motion was then carried, and Sir Wm. Forwood and Mr. Harold Brocklebank were re-elected directors.

Westminster Electric Supply Corporation.

The directors' report for the year 1904, states that during the year the equivalent of 662,129 lamps of 8 c.p. increased to the equivalent of 711,679 lamps, and applications for supply continue to come in at a satisfactory rate.

The length of roadway in which continuous current mains have been laid now exceeds 75 miles, making about 286 miles of ways, into which upwards of 234 miles of copper (strip and cable) have been drawn. In addition, 3 miles of trunk mains (12 miles of ways) are laid in the company's area to connect the stations with the Central Electric Supply Co.'s station at St. John's Wood. The system of public lighting undertaken by this Corporation continues to give great satisfaction. The station of the Central Electric Supply Co. at St. John's Wood has been working well during the year, and has supplied a large amount of current to this company at a considerably lower rate than in the previous year. The new transformer station at Duke Street Gardens is not yet completed, but arrangements having been made for part of the space to be available for the engineers, the first section of plant has been erected and came into use on November 25th last. The result of the year's working justifies the directors in once more recommending an increased dividend, viz.—14 per cent. There being a growing demand for current at a low price, the directors consider that any additional profits should for the present be devoted to the development of the company's business by the reduction in the rates of charge. A reduced scale of charges came into force on January 1st, which will naturally affect the receipts for the current year, and it is, therefore, necessary to carry forward a sum of money sufficient to meet the temporary diminution of profits which may result from the reduction in price. An interim dividend at the rate of 13 per cent. per annum on the ordinary shares and the dividend on the 5 per cent. preference shares, for the half-year ending June 30th, 1904, have been distributed. After allowing for depreciation, sinking fund and other charges, the net balance is £56,328 11s. 4d., from which must be deducted the second half-year's dividend on the preference shares, which absorb £3,342 14s. 10d., leaving a balance of £52,985 16s. 6d. Out of this the board recommend the payment of dividend at the rate of 15 per cent. per annum, less income-tax, for the past half-year, carrying forward a balance of £13,798.

Statement of Electricity Sold, &c., Year ending December 31st, 1904.

Quantity utilised.			No. of lamps on circuit, Dec. 31st, 1904.
Sold to consumers.	Used on works for lighting, meter testing, &c.	Total.	
14,513,764 [13,086,596]*	162,893 [160,288]	14,676,657 [13,246,834]	711,679 [662,129]

Alex. B. W. Kennedy, *Engineer-in-Chief.*

* [The bracketed figures indicate the numbers of lamps and units at December, 1903. The quantity expended in distribution is not stated this year. Eds. E.R.]

Waterloo and City Railway Co.

Sir Charles Scotter presided on 9th inst. over the half-yearly general meeting of this company, held at Waterloo.

In moving the adoption of the report and balance-sheet, the Chairman said that the half-year which had just closed had been a very favourable one for the company, although it had not been so favourable for other similar railways. During the corresponding period of last year they had paid a dividend of 3 per cent. only, but this half-year they were proposing an increased dividend of 3½ per cent. The working expenses of the company had been reduced by £140 during the half-year, and he thought they had not yet got to the limit of reduction. Electricity was making rapid strides, and alterations tending to economy were being made in all directions. There was one other little matter which the directors had been considering. It had been suggested that the Waterloo and City Railway should supply the electricity for lighting Waterloo station. It had been found that this could be done, and, of course, whatever margin of profit there might be, would be to the good of the company. A very small increase of net revenue would make a tangible increase in the dividend. He had little to say with regard to the half-year's working. They had carried nearly 16,000 more daily passengers, and there had also been an increase in the number of season ticket holders. Surely their little dividend would in time grow as well. There was one interesting feature in connection with the traffic. Saturday was their best day, which was a very curious thing, seeing that the City was practically empty during part of that day. He thought it might be accounted for by the number of clerks who rushed out of the City on a Saturday for football or golf. Since the commencement of the line they had carried some 30 million passengers without accident, so that he thought the line might be considered the safest place in the world. During the whole of the past half-year there had been only one or two delays, and those of only some few minutes' duration. In conclusion, the Chairman said that the directors were very much indebted to Mr. Jones, the electrical engineer to the company. The result of the economical working had been largely due to his foresight.

The motion was seconded by Sir Algernon West.

Mr. Laurie, a shareholder, raised the question of Sunday working. He thought it was a most surprising thing that the line should be closed on that day, when it would be so largely used by people who wished to go down to stations on the South-Western. In these enlightened days, it was extraordinary that any railway should be asleep on a Sunday. There was also the question of the awkward approach to the railway in the City. Could nothing be done to remedy that?

Other shareholders having spoken, the Chairman replied. Dealing first with the question of Sunday traffic, he said that the matter had not been recently considered by the directors. He admitted that the circumstances which obtained at present were not the same as those when the line was opened. Since then the Central London had been opened, so that their own line formed a connecting link between Waterloo and Shepherd's Bush. He was not sure, at least this was his own opinion, that the time had not come when the receipts might well be augmented by opening the line on Sundays. The directors would consider the matter at their next meeting. He was afraid that nothing could be done in regard to the long passage at the City end of the line. They had at one time considered the possibility of a moving staircase, but had found that it would be too expensive. Alluding to the question of fares which had been raised by one of the shareholders, he said that he thought it was to the best interests of the company to keep the fares as they were; rather than raise them he would reduce them. He would not like to face the question of advanced fares at present.

The report was then adopted.

Smithfield Markets Electric Supply Co.

Mr. H. S. Leon presiding at the annual meeting last Friday, moved the adoption of the report (see Electrical Review, February 3rd, p. 195), and said that the figures were not quite so good as in the previous year, but considering the state of trade and the general bad times, the decrease was not of importance. The capital account showed that an expenditure of only £1,100 during the year, including £800 for the new boiler, the benefit of which they would receive in the coming year. They had spent out of revenue up-to-date £3,954. Unless there was some remarkable change of circumstances in the way of new business they did not intend to raise any fresh capital. On the contrary, they proposed directly they had enough money, to pay off the second debentures. To do that would be practically the same as writing down the value of the plant, stock, &c. The sale of current showed a decrease of about £400. A great deal of economy had been practised by consumers in the market, but it was only temporary, and already there was a move in the other direction again. The expenses had decreased in about the same proportion, in spite of their having freely spent revenue money in keeping the plant in an efficient state. The reserve fund had now reached £5,740, and the depreciation fund £3,300, of which they had £3,300 in cash, and the balance was being used in the ordinary way in the business as working capital. The carry-forward of £1,600 might appear rather large, but there might be some difficulties this year which would perhaps be a little troublesome, and they though they ought to keep some cash in hand in order to surmount them. They had not lost customers. They had sold a few units less but more lamps were connected. The price had been reduced slightly, and the economy in the market had been marked.

The report was adopted.

Newcastle Electric Supply Co.—The directors have resolved that the following dividends be recommended for the year ending December 31st, 1904:—2½ per cent. on the amount called up on the preference shares, making, with the interim dividend paid in July last of 2½ per cent., a total of 5 per cent. for the year; 5½ per cent. on the amount called up on the ordinary shares (other than those mentioned below), making, with the interim dividend of 2½ per cent., paid in July last, 8 per cent. for the year; 3½ per cent. on the ordinary shares allotted in connection with the purchase of the Walker and Wallsend Union Gas Co.'s electricity undertaking, making, with the interim dividend of 2½ per cent. paid in July last, 6 per cent. for the year. These shares are by agreement limited to a dividend of 6 per cent. per annum for two years, as from January 1st, 1903.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in—

Havana Electricity Co., Ltd.—Scrip (fully and partly paid) for £150,000 5 per cent. debentures.

And to allow the following securities to be quoted in the Official List:—

City of Buenos Ayres Tramways Co. (1904) Ltd.—248,000 shares of £5 each, fully paid, Nos. 1 to 248,000, and £174,000 4 per cent. debenture stock, in lieu of the shares and debenture stock of the City of Buenos Ayres Tramways Co., Ltd., now quoted.

The Committee has appointed Thursday, February 23rd, as a special settling day in—

Marconi's Wireless Telegraph Co., Ltd.—Further issue of 80,116 shares of £1 each, fully paid, Nos. 196,112 and 221,128 to 251,127.

South London Electric Supply Corporation.—Subject to final audit, the directors recommend a dividend on the ordinary shares at the rate of 4 per cent. for the past year. The 1903 dividend was 3 per cent.

Great Northern, Piccadilly and Brompton Railway Co.—The report states that during the second half of 1904 the capital expenditure amounted to £644,896. The estimate for the current half-year is £750,000. The progress of the works during the past half-year has been satisfactory. The rent due from the Underground Electric Railways Co. of London permits of a dividend at the rate of 4 per cent. per annum. The half-yearly meeting was held on Wednesday. Sir H. Fowler, said, that at the next meeting, he would be in the position to give some definite idea of when the line would be opened for traffic.

Brompton and Kensington Electricity Supply Co.—The directors have declared a dividend for the half-year ended December 31st last at the rate of 11 per cent. on the ordinary shares, making, with the interim distribution, 10 per cent. for the year. (This is at the same rate as for 1903.)

New Companies in 1904.—The *Investors' Guardian's* table of company registrations during 1904 show a big decrease as compared with the previous 12 months. The figures are:—1903: 3,693 companies with £115,688,478 capital. 1904: 3,481 companies with £83,861,188 capital. In the classification of industries, the following figures are given:—

	1904.	1903.
Electric	£2,178,755	£3,914,400
Engineering and hardware	7,119,952	6,750,537
Gas	815,930	371,620
Railways and tramways	3,894,878	2,429,303

City of London Electric Lighting Co.—We congratulate the shareholders of this company upon a 1 per cent. increase in the dividend for 1904, as compared with 1903, for we understand that the directors have decided (subject to the completion of the audit) to transfer the sum of £45,500 to reserve account, and to recommend to the shareholders the payment of the following final dividends for the year ended December 31st, 1904:—*Preference Shares.*—6s. per share, making, with the dividend paid in July, a total of 12s. per share, or 6 per cent. per annum, less income-tax. *Ordinary Shares.*—7s. per share, making, with the dividend of 5s. paid in July, a total distribution of 12s. per share, or 6 per cent. per annum for year, less income-tax. The above appropriations leave a carry-forward of about £22,000. For 1903, the carry-forward and the allocation to reserve were exactly the same as above.

Oxford Electric Co.—The dividend for 1904 is to be 7 per cent. per annum (including the interim dividend of 2½ per cent.). The rate for 1903 was 6½ per cent.

Prospectus.—Messrs. Speyer Bros. are offering £500,000 of 4 per cent. perpetual debenture stock in the Baker Street and Waterloo Railway at 96 per cent. The lists close to-morrow.

Mather & Platt, Ltd.—Interim dividend on ordinary shares at the rate of 6 per cent. per annum for the six months ended December, 1904.

STOCKS AND SHARES.

Wednesday Evening.

Investment orders in the Stock Exchange have quite eclipsed those which find their way to the speculative divisions. The City is thoroughly convinced that a 2 per cent. Bank Rate will only tarry for a month or two; the King's Speech at the opening of Parliament on Tuesday assisted the cheeriness, and, from the chaos in Russia, the hope of peace in the Far East is daily strengthened. Four per cent. stocks are in very active demand, and a glance down the improvements recorded on the succeeding pages by Debenture prices leaves no room for doubt as to the increasing character of the investor's confidence.

Dividend announcements, payments and deductions have caused a variety of changes in prices all through the electrical sections. Waterloo and City Railway Ordinary at 92 has recovered the distribution of 1¼ per cent., but the Central London prices are content to remain with the dividend-deductions shown in the quotations; except that the Preferred is 1 down, instead of 2. Fresh weakness in City & South London lowered the stock to 44½, a fall of 1½, of which only ⅞ has to be allowed for the interest. Metropolitan Consolidated at 96 *ex* is practically unaltered, but Districts are a shade better at 41¾, upon the statements made at the meeting. The chairman at that gathering made no effort to explain away the damaging figures set forth by an evening contemporary, showing the distance which District Ordinary is still away from chances of a dividend, although he alluded feebly to the criticism. Obviously, District stock can be deemed nothing better than a gamble, although, as we have remarked previously, the price may be hoisted when the electrification advertisement for the line comes along.

With every day the report of the British Westinghouse Co. becomes more anxiously awaited by the proprietors of the Preference shares. The price is 2$\frac{9}{16}$, and it is said that a passing of the dividend once more must be faced as a possible contingency. Nevertheless, holders might be ill-advised to realise now, because even though it may take a year to put the company into a sound financial position, the chances are that it will pull round again in time.

After the drop caused by the little 'bus *v.* tram controversy British Electric Traction Ordinary are ¼ better at 9½, and the Preference, allowing for the 6s. taken off, are ⅛ harder at 11½ *ex* dividend. Anglo-Argentine Trams have eased off a trifle at 8⅜, but the market idea is that the price will not be long in getting to 9. In the light of this opinion, it must also be remembered that public interest in Argentine matters shows signs of waning for the time being. London United Tramway Debenture fell a point to 104. Business has been recorded this week in Metropolitan Electric Trams Debenture at 106, and in North Metropolitan shares at 4½. There is more doing in British Columbia Electric Railway stocks, with the Deferred about 103½, and the Preferred at a little over par. As bearing upon the problems of motor traction, it may be remarked that the light 'buses, some of which were introduced to Hammersmith two or three months ago, are not regarded as successful, on account of the small number of passengers they carry. Therefore the old style of 'bus, motorised, seems likely to prevail until the new Motor Omnibus Co. gets its cars on the roads.

If the City of London Electric dividend did not fulfil the more sanguine anticipations, it sufficed to advance the price of the shares to 12¾, a rise of 10s. South Londons are ⅛ down at 4⅜ upon a few sales by those who confidently expected a 5 per cent. distribution. There is ⅛ rise in London Electric Preference at 5⅞, and Metropolitans continue to improve, another rise of 5s. making the price 18½. The Preference at 5$\frac{11}{16}$ are $\frac{1}{16}$ harder. Generally the Metropolitan is the last of the important lighting companies to announce its dividend. Two or three undertakings have published their reports, but they contain nothing sufficiently striking to cause any change in values.

Four-and-twenty rises in the telegraph and telephone market are directly due to the increased investment demand. Debentures in this department are decidedly better. Western Telegraph 4 per cent. Debenture has gone up 1½; other rises do not exceed a point each. Eastern Telegraph Ordinary came into favour, and put on 3 per cent. at 139½, Eastern Extensions stopping at 13¾. Anglo-American Telegraphs are strong. Anglo "A" jumped ¾ to 13¾, after being 14⅜. On February 1st the price was 11⅝, and a strong Continental syndicate is endeavouring to get control of the stock. The Ordinary has got back its dividend of ⅝ per cent., and the Preferred, while nominally down 2, is *ex* 1¾ per cent. Direct United States are ¼ harder at 11⅜, a rise of 12s. 6d. in the fortnight, but Submarine Cables Trust keep about 122½. Globes exhibit no move. Steady buying of Cuban properties led to Cuba Telegraphs being raised ½ to 17½. Direct Spanish Preference are ¼ up. Indo-Europeans at 47 show the rise of a sovereign, and Great Northerns remain about 30. West India and Panama issues are decidedly better in each of the four cases. Of the Telephone descriptions, National Deferred has recovered to 110, a gain of 2, and the Preferred is up ½ at 109½. Oriental Preference follow the rise that occurred last week in the Ordinary, and Chili Telephones rose ⅛ to 6⅜.

Several of the "Miscellaneous" shares are better. Callender's Preference and Henley's Preference have both improved to 5½, and a feature has been strong buying of Babcock & Wilcox Ordinary. The price is 4½, after being 4⅜. Brush Preference improved to 1½, and the second Debenture stock is harder. The 5 per cent. First Debenture stock of the British Aluminium Co. is 2 better at 100. Another Debenture just introduced to the market is the 4 per cent. stock of the Baker Street and Waterloo Railway, offered at 96 by Messrs. Speyer Bros. In the market, a premium of about a point has been established. It may be observed that Great Northern and City 4 per cent. Debenture stands about 92, and it was nearer 80 not long ago.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1902.	1903.	1904.	Closing Quotations Feb. 8th.	Closing Quotations Feb. 15th.	Business done week ended Feb. 15th, 1905. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 –102	99 –102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	1 — 1⅛	1 — 1⅛	..	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	60/6	61s.	2⅜%	58 — 60	58 — 60 xd	59½	58⅝
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅛%	105 — 107	103 –105 xd	106½	104
3,105,580	Do. do. do. Deferred	Stock	1/-	2s.	Nil	12⅝ — 13⅛	13⅜ — 13⅝	14⅛	13½
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	..	6⅛ — 6⅜	6½ — 6¾	..	..
13,333,300§	Commercial Cable	$100	8 %	..	..	170 –190	170 –190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	95 — 97	95 — 97	96⅝	96⅜
16,000	Cuba Telegraph	10	6⅔%	5 %	..	8⅞ — 9¼	8¾ — 9¼	..	..
6,000	Do. 10 % Pref.	10	..	..	..	16⅞ — 17⅛	17 — 18	17½	..
12,931	Direct Spanish Telegraph, Ord.	5	..	..	..	3⅜ — 3⅝	3⅜ — 3⅝	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7⅞ — 8¼	8 — 8⅛	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	100 –102	100 –102	..	..
60,710‡	Direct United States Cable	20	8½%	3 %	..	11⅛ 11⅜	11 — 11⅛	11 7/16	11⅛
78,500	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 –101	100 –102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	135 — 138	138 —141	141	137½
1,955,555	Do. 8½ % Pref. Stock	100	..	..	..	87 — 89	88 — 90	89	87¾
1,584,445	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —107	106 —108	..	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	13½ — 14	13½ — 14	13⅞	13½
320,000‡	Do. 4 % Deb. Stock	Stock	..	..	..	104 —106 xd	104 —106	105	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 –101 xd	100 –102	100	..
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 –102	101 –103	..	..
180,227	Globe Telegraph and Trust	10	£3 16 7*	5½%	..	10½ — 10¾xd	10½ — 10¾	10¾	10⅝
180,042	Do. do. 6 % Pref.	10	..	..	..	13⅝ — 14⅛xd	13⅝ — 14⅛	14⅛	13 15/16
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	..	29½ — 30½	29½ — 30½	31	29½
50,600	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 –101	100 –102	..	..
17,000	Indo-European Telegraph	25	10%	10 %	..	45 — 47	46 — 48	46⅜	..
72,680	Monte Video Telephone Co., Ltd., Ord.	1	3 %	3 %	..	13/16 — 15/16	13/16 — 15/16	..	..
1,988,888	National Telephone, Pref. Stock	100	6 %	6 %	6 %	108½ –109½	109 –110	110	109⅜
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	107 — 109	109 —111	111	110
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13⅝	13½
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	12⅝	12 11/16
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	2⅜%	5½ — 5¾	5½ — 5¾	5 1/16	..
000,000‡	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	4 %	96 — 98	97 — 99	98⅜	97½
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	..	101½ –103½	102 –104	103⅜	..
1,000,000	Do. do. Prov. Certs., all paid	..	..	..	..	101½ –103½	102 –104	104	101½
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6⅛%	..	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1⅛ — 1¼	1 3/16 — 1 5/16	..	..
100,000‡	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 – 100	98 –101	..	..
11,889	Reuter's	8	5 %	..	..	7 — 7½	7 — 7½	7 7/16	..
3,808	Submarine Cables Trust	Cert.	..	..	..	121 –124	121 –124	123	..
58,000	United River Plate Telephone	5	7 %	..	..	6⅞ — 7¼	7 — 7½	7⅛	7 3/16
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	5 — 5¼	5 — 5¼	..	..
179,947‡	Do. do. 5 % Debs.	Stock	..	..	..	105 –107	105 –107	107	..
15,609	West African Telegraph, Shares	10	2 %	4 %	..	7½ — 7⅞	7½ — 7⅞	..	..
80,008	West Coast of America, 1 to 80,000 and 53,001 to 53,008	2½	..	..	..	5/16 — 7/16	5/16 — 7/16	..	..
150,000‡	West Coast of America, 4% Debs., 1 to 1,500 guar. by Brss. Sub. Tel.	100	..	..	..	99 –101	99 –101	..	..
307,980	Western Telegraph, Ltd., Nos. 1 to 307,980	10	7 %	7 %	..	13⅛ — 14	13⅛ — 14	13⅛	13⅜
75,000‡	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 –103	101 –103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	100½ –102½	102 –104	..	..
88,821	West India and Panama Telegraph	10	..	..	..	11/16 — 13/16	8 — 8½	8 5/16	23/32 7/8
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	7⅛ — 8	7½ — 8	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	6¾ — 7½	7½ — 8	..	..
80,000‡	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	101 –103	102 –104	102½	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	8⅞ — 9⅛	9 — 9⅛	..	..
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	9 — 9⅛	9⅛ — 10	9⅛	9 1/16
800,000‡	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	96 — 100	98 — 102	..	..
100,000	British Electric Traction	10	8 %	..	..	9 — 9⅛	9⅛ — 9⅜	9⅜	9 3/16
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	11⅛ — 11⅜	11 — 11⅛xd	11 1/16	11 1/16
600,000‡	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	122 –120	120 –122	121⅛	121
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	97 — 99	95 — 97	98½	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	..	6⅛ — 6⅜	5⅞ — 6⅛	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5 — 5⅛xd	5⅛ — 5⅜	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	101 –104	101 –104	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	..	..	..	5/16 — 7/16	5/16 — 7/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	..	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	..	1/4 — 3/8	1/4 — 3/8	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	..	1⅛ — 1⅜	1⅛ — 1⅜	1⅛	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	93 — 96	93 — 96	..	..
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	75 — 78	77 — 80	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	..	9⅛ — 10	9⅛ — 10	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	..
90,000‡	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	104 –106	105 –107	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	..	91 — 93	90 — 92 xd	91¾	91
494,098	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	..	101 —103	99 –101 xd	..	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	..	85 — 87	81 — 83 xd	..	..
1,330,000	City and South London Railway	Stock	3½%	2¾%	2⅝%	44 — 47½	44 — 45 xd	47½	44
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	..	..	2½ — 2⅔	2½ — 2⅔	..	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	98 — 8	93 — 98	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	..	..	3/8 — 7/16	3/8 — 7/16	..	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	..	..	1 — 1⅛	1 — 1⅛	..	..
344,028‡	Do. do. 4 % Deb. Stock Red.	100	..	..	..	77 — 82	77 — 82	..	..
100,000‡	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 84	79 — 84	..	..
112,100	lectric Construction 1 to 112,100	1	6 %	4 %	..	1⅛ — 1⅜	1⅛ — 1⅜	1 3/8	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	1	..	..	..	2⅛ — 2⅜	2⅛ — 2⅜	2⅜	..
62,500‡	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 — 99	97 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	..	..	9 9½ — 10	9⅛ — 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	91 — 96	91 — 96	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	15 %	..	10⅜ — 11⅛	11 — 11⅜	11⅜	11⅛
200,000	Do. do. 4½ % Pref.	5	..	..	..	5⅝ — 5⅞	5⅝ — 5⅞	5⅞	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	110 —112	111 —113	111⅛	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	..	..	15 — 16	15 — 16	16	15⅜
800,000‡	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 –102	99 –102	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	0 1⅝%	1⅝%	1¼%	3⅝ — 3¾	3⅝ — 3¾	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	9½ — 10½	..	..
37,350	Telegraph Construction and Maintenance	75	20 %	20 %	15 %	34 — 37	34 — 36	36	33
150,000‡	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101½ –103½	101½ –103½	92⅜	91
540,000‡	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	..	91 — 93	92 — 94	93	92⅜

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

(Bank rate of discount 3 per cent. (April 21st, 1904).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).— ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years 1902.	1903.	1904.	Closing Quotations Feb. 8th.	Closing Quotations Feb. 15th.	Business done week ended Feb. 15th, 1905. Highest.	Lowest.
		‡							
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£	8 %	10 %	..	10¾ — 11	10¾ — 11	..	..
20,000	Do. do. 7 % Cum. Pref. ..	£	..	..	..	10¾ — 10⅞	10¾ — 10⅞	10⅛	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	105 —108	105 —108	107	..
50,000	Charing Cross and Strand Electricity Supply	£	10 %	8 %	8 %	8⅛ — 8⅜	8⅛ — 8⅜	8⅛	8⅜
70,000	Do. do. 4½% Cum. Pref. ..	£	..	..	..	5⅜ — 5⅝	5⅜ — 5⅝	5⅜	5⅝
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	£	..	..	..	4 15/16 — 5 1/16	4 15/16 — 5 1/16	5 3/16	..
40,000	Do. do. 1903	£	..	..	..	4 15/16 — 5 1/16	4 15/16 — 5 1/16	5 3/16	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104	102 —104	103	102¼
44,486	*Chelsea Electricity Supply, Ord.	£	4½%	5½%	6 %	6⅜ — 7⅛	6⅜ — 7⅛	6 13/16	6⅞
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —110	108 —110	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	£	5 %	5 %	6 %	12 — 12⅛	12⅛ — 13	12⅞	12½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£	..	..	..	13⅛ — 14	13⅛ — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	122 —126	122 —126	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —104	102 —104	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£	4 %	4 %	..	9 — 9¼	9 — 9¼	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60 ..	£	..	..	..	12 — 12⅝	12 — 12⅝	..	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	108 —110	108 —111	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	102 —104	102 —104	102⅜	102¼
70,000	Edmundson's Electric Corporation, Ord. Shares	£	7 %	7 %	..	6⅛ — 6⅜	6⅜ — 6⅛	6 7/16	6⅜
70,000	Do. do. 6 % Cum. Pref.	£	..	..	..	6 — 6⅛	6 — 6⅛	6⅛	6⅛
800,000‡	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	106 —108	106 —108	107½	..
21,000	Kensington and Knightsbridge Electric Ord.	£	10 %	12½	12 %	13 — 13½	13 — 13½	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —104	102 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	£	..	..	3 %	2⅜ — 2⅝	2⅜ — 2⅝	2 7/16	..
49,840	Do. do. do. 6 % Pref.	£	..	..	..	5⅝ — 5⅞	5⅝ — 6	5⅞	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	96 — 98	96 — 98	98½	..
100,000	Metropolitan Electric Supply, 1 to 100,000	£	7½%	8⅜%	..	18 — 18¼	18⅛ — 18⅜	18⅝	18⅛
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	£	..	..	..	5 9/16 — 5 11/16	5 9/16 — 5⅝	5⅝	5⅝
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —115	110 —115	113½	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 98	96 — 98	97½	97¼
10,852	Notting Hill Electric Lighting	£	6 %	6 %	..	14½ — 15½	14½ — 15½	..	..
59,000	Do. do. 4% 1st Mort. Deb.	100	..	..	..	102 —104	102 —104	103⅜	103¼
40,000	St. James' and Pall Mall Electric Light, Ord.	£	14½%	14½%	14½%	13⅜ — 14¼	13⅜ — 14¼	14 1/16	13 15/16
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	£	..	..	..	8¾ — 9	8¾ — 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —100	98 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£	2½%	4 %	..	2⅜ — 3½	2⅜ — 3½	..	..
50,000	Do. do. do. 4 % Deb. Stock Red ..	Stock	..	..	..	83 — 87	82 — 86 xd	..	..
65,000	South London Electricity Supply, Ord.	£	..	12½%	8 %	4⅜ — 4⅝	4⅜ — 4½	4 7/16	4⅜
100,000	South Metropolitan Electric Light and Power (Ord. ..	£	..	..	..	⅞ — 1	⅞ — 1	..	..
50,000	(*Late Blackheath and Greenwich* 7 % Pref. ..	£	..	..	..	1⅜ — 1 7/16	1 13/16 — 1 15/16	..	..
100,000	*Dist. E.L.Co.*) 4½% 1st Deb. Stock	100	..	..	..	107 —110	107 —110	..	..
80,000	Urban Electric Supply, Ord.	£	..	..	..	5 — 5⅛	5 — 5⅛	5⅛	..
80,000	Do. do. 5 % Cum. Pref.	£	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	5 5/16
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red	100	..	..	..	105 —107	105 —107	106	..
110,000	Westminster Electric Supply, Ord.	£	12 %	13½%	14%	13 — 13⅛	13 — 13⅛	13⅜	13⅛
28,141	Do. do. 5 % Cum. Pref.	£	..	..	..	6⅞ — 6⅞	6⅞ — 6⅞	6 15/16	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the week or fortnight. £	£*	No. of wks.	Total to date. £	£*	Miles open.	*
Aberdeen	Feb. 11	2,146	— 21	37	50,972	+ 5,756	10	..
†Ayr	,, 4	175	+ 10	38	11,732	+ 533	..	..
Bath	,, 8	1,046	+ 67	6	3,186	+ 379	12½	..
Birkenhead	,, 12	1,982	— 21	45	47,319	— 86	13½	..
Blackburn	..	..	..	..	..	..	13½	..
Blackpool	,, 9	613	+ 83	45	45,299	+ 6,087	15½	..
,, —Fleetw'd	,, 11	399	— 6	6	1,187	— 106	7½	..
† ,, — Lytham	,, 9	136	— 15	15	1,868	..	7½	+ 3/4
Bolton	,, 5	3,295	— 38	45	81,953	+ 364	25	..
Bournemouth ..	,, 8	1,695	— 15	45	48,387	..	10·15	..
Bradford	..	..	..	..	..	..	54	..
Brighton	,, 12	1,477	+ 12	45	44,920	..	9½	..
Bristol	,, 10	9,015	+ 16	..	..	..	2·	..
Brit. Elec. Trac. Co.								
Airdrie	,, 3	387	..	5	967	..	..	..
Barnsley	,, 8	298	+ 7	,,	695	+ 21	..	..
Barrow	,, 3	361	..	,,	840	..	..	..
Birmingham (City)	,, 3	‡10,940	+ 124	,,	‡24,826	+ 317	31½	..
Birmingham (Mid.)	,, 3	‡3,264	+ 325	,,	‡7,740	+ 691	..	..
Devonport ..	,, 8	832	- 59	,,	2,111	— 86	5	..
Dudley—Sto'rb'ge	,, 3	1,451	+ 20	,,	3,384	— 15	18¾	..
Gateshead	,, 3	1,725	- 7	,,	4,114	+ 53	10½	+ 3/4
Gravesend, N'fleet	,, 3	361	— 35	,,	873	— 85	..	..
Gr'n'k, Pt. Glsgw	,, 3	994	+ 28	,,	2,464	+ 282	7½	..
Hartlepool ..	,, 3	464	— 22	,,	1,133	— 31	..	..
Kidderminster ..	,, 3	177	— 2	,,	430	— 1	..	..
Merthyr	,, 3	360	— 18	,,	811	— 74	..	..
Metropolitan ..	,, 3	‡3,774	+1,694	,,	‡9,047	+ 3,945	..	..
Middleton	,, 3	518	+ 57	,,	1,214	+ 92	..	..
Oldham — Ashton	,, 3	973	— 9	,,	2,301	+ 6	8	..
Peterborough ..	,, 3	194	— 18	,,	471	— 32	..	..
Poole	,, 3	818	— 6	,,	1,017	— 24	..	..
Potteries	,, 3	3,252	+ 5	,,	7,724	+ 254	29¾	..
Rothesay	,, 3	78	— 3	,,	214	+ 14	..	..
Sheerness	,, 1	99	+ 12	,,	237	+ 33	..	..
Southport	,, 3	418	— 70	,,	1,040	- 98	..	..
South Staffs. ..	,, 8	1,2.0	— 159	,,	2,981	— 267	21¾	— 3/4
Swansea	,, 3	903	— 21	,,	2,120	— 26	5½	..
Taunton	,, 3	74	— 18	,,	189	— 31	..	..
Tynemouth	,, 3	343	— 69	,,	803	— 152	..	..
Weston-s-Mare ..	,, 1	48	— 6	,,	121	+ 16	..	..
Wolverhampton D.	,, 3	6·0	+ 28	,,	1,585	+ 55	10⅜	+8
Worcester	,, 3	493	+ 284	,,	1,178	+ 674	..	..
Wrexham	,, 3	183	14	,,	422	— 34	..	..
Yorks. Wool. Dist.	,, 3	1,126	+ 158	,,	2,585	+ 257	6	..
Burnley	Feb. 11	2,061	+ 336	..	..	..	10¾	..
Burton-on-Trent ..	,, 12	482	— 16	45½	15,429	..	6¾	..
Bury	..	..	..	..	..	..	..	..

Locality.	Fortnight ended.	Receipts for the week or fortnight. £	£*	No. of wks.	Total to date. £	£*	Miles open.	*
†Cardiff	Feb. 4	1,810	— 37	44	89,928	+ 2,084	14	..
Carlisle	,, 11	279	— 57	6	878	— 147	..	..
Chatham and Dist.	,, 9	1,182	+ 138	6	3,283	+ 263	9·33	+ ·8
Colchester	,, 8	309	..	28	6,557	..	..	..
Cork	,, 9	820	+ 45	6	2,321	— 47	9·9	..
Coventry	..	..	..	..	..	..	..	..
†Darlington	,, 4	186	..	36	6,926	..	4·87	..
Darwen	,, 10	420	— 2	45	10,283	— 97	4·36	..
Dundee	,, 8	1,605	+ 1	37	32,057	+ 291	4½	..
Dover	,, 4	325	— 2	5	883	—½ 61	3¼	..
Dublin	,, 10	9,040	+ 284	..	26,011	+ 380	48	+ 1
East Ham	,, 11	1,276	+ 101	45	31,997	+ 1,737	6⅔	..
Glasgow	,, 11	27,952	+2,127	36½	526,059	+25,475	72½	+ 3
Halifax	,, 8	2,411	+ 216	45	64,971	+ 4,789	34½	+ 3
Huddersfield ..	,, 11	2,396	+ 245	45	61,188	+ 3,876	26	..
Hull	,, 11	4,084	+ 40	45	98,606	+10,905	13	..
†Ilford	Jan. 28	327	+ 12	44½	19,411	+ 953	6⅔	..
Ilkeston	Feb. 8	111	— 34	45	6,008	..	3½	..
Ipswich	,, 11	655	+ 12	45	21,049	..	10½	..
Isle of Thanet ..	,, 11	467	+ 23	6	1,384	+ 104	10½	..
Kirkcaldy	,, 8	391	+ 7	..	..	..	..	..
Lan'kshire Trm. Co.	,, 11	1,231	+ 122	6	3,765	+ 214	8·6	..
Leeds	,, 14	10,755	+2,055	46	262,859	+14,772	89½	+ 8½
Leicester	,, 11	3,562	..	6	10,313	..	..	..
Liverpool	,, 4	19,377	+ 395	5	48,858	+ 1,212	108	..
L.C.C.	Jan. 28	23,518	+5,764	47½	550,060	+122,316	472	+ 7/8
Lowestoft	Feb. 11	250	— 17	..	..	..	4	..
Manchester	,, 11	23,192	+1,944	45	548,256	+24,371	187½	+ 12½
Newcastle	,, 11	7,217	+ 153	..	..	..	17	..
Newport	,, 11	989	+ 87	19	9,624	+ 1,303	14½	+ 1/2
Oldham	,, 12	2 766	+ 661	46	57,643	+ 4,055	29½	+ 1/2
Plymouth	..	..	..	..	..	..	..	..
†Portsmouth ..	,, 11	1,414	+ 41	45½	85,807	+ 6,447	14½	..
†Reading	Jan. 26	495	+ 4	43	27,583	..	7½	..
Rochdale	Feb. 11	827	+ 627	45	11,831	..	14·8	+ 10½
Salford	,, 6	7,669	+ 345	44	180,360	+ 8,752	30	..
†Scarborough ..	,, 4	165	..	5	‡35	..	3½	..
Sheffield	,, 12	8,909	+½ 547	46	214,024	+ 5,691	84½	+ 1/2
†Southampton ..	,, 8	802	— 85	45	43,467	— 2,493	16½	..
Southend-on-Sea ..	,, 8	438	+ 43	45	15,705	+ 1,575	6½	..
†Stockport	Jan. 27	405	+ 49	43	23,774	+ 8,244	11½	+ 1
Sunderland	Feb. 11	2,189	+ 37	45	56,904	+ 1,454	21	1
Tyneside	,, 8	668	+ 66	6	1,912	+ 211	8·9	..
Warrington	,, 2	101	+ 33	44	14,165	+ 509	7½	..
West Ham	,, 9	2,154	..	50	48,367	..	9·8	..
Wolverhampton ..	,, 8	1,367	+ 580	..	..	..	..	..
†Cen. London Rly.	Feb. 4	7,072	+ 78	5	36,074	+ 877	6	..
City & S. Lon. Rly.	,, 12	5,801	— 735	7	21,401	— 1,184	6½	..
Dublin-Lucan Rly.	..	..	..	..	..	..	..	..
G. N. and City Rly.	,, 11	3,219	+ 15	6	9,526	..	3½	..
L'pool Overh'd Rly.	,, 12	3,003	— 10	7	10,333	— 412	6·6	..
Mersey Railway ..	,, 11	3,173	+ 242	6	9,684	+ 664	4½	..

* Compared with the corresponding period of 1904. † One week only. ‡ Includes horse and other receipts.

ELECTRIC WINDING GEAR.

Messrs. Ernest Scott & Mountain, Ltd., of Newcastle-on-Tyne, have recently shipped to Spain, to the order of Messrs. Mason and Barry, London, an electric winding gear for use in a Spanish copper mine.

This gear is fitted with two drums each 4 ft. 8½ in. diameter, × 24 in. wide, and is capable of raising 20 cwts. of ore at a winding speed of 375 ft. per minute. Each drum is mounted on its own shaft, and a hole is made near one side of the barrel to allow the rope to pass in to the shaft.

Each drum shaft is independently driven by its own gear. These shafts are 6 in. diameter through the drums and bearings, and are provided with loose collars at each end 3 in. diameter × 1 in. long; the diameter of the shafts through the wheels is 7½ in.

The drum shaft carriages are four in number, each bearing consisting of a cast-iron pedestal with adjustable keeps, and fitted with bored and turned brasses of large dimensions. The intermediate shafts are also two in number, running in two bearings, each 4 in. bore × 8 in. long, and fitted with brasses.

On these intermediate shafts are fitted friction clutches of the expanding type, each clutch being capable of transmitting 50 H.P., and provided with a long boss to receive the spur-wheel. The clutches are bushed with gun metal, and provided with ample lubricating arrangements; they operate by means of hand-wheels and screws, through weigh-bars fitted with wrought-iron arms, the top end of each having a pair screwed in to take the dies for sliding the clutches. The ends of the weigh-bars are carried by cast-iron brackets.

The first motion shaft is of steel, 3 in. diameter, running in two bearings, each 3 in. diameter × 6 in. long, one end of this shaft being provided with a coupling to take the electric motor coupling. The brake gear is operated by means of foot levers with the necessary ratchets; the brake blocks are of cast-iron, and are readily renewed.

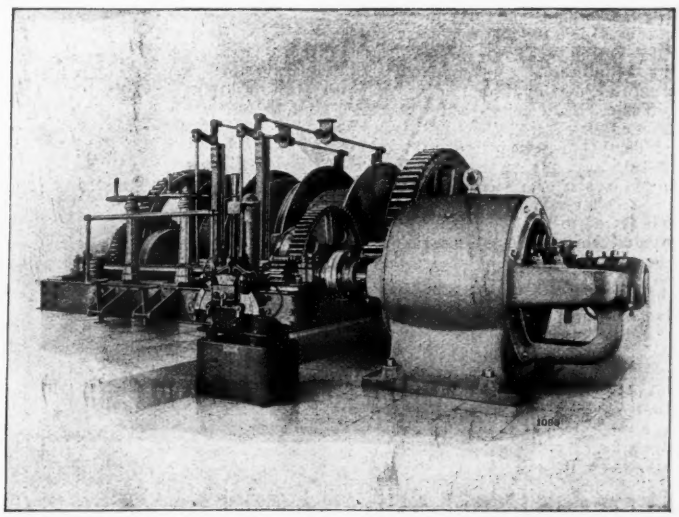
On the drum shafts two sets of spur gearing are provided with double shrouds, turned true to the pitch line, each wheel having 75 teeth, 3-in. pitch, 7-in. face, and the two pinions on the intermediate shaft which drive these spur-wheels are fitted with 15 teeth each. The spur-wheels on the intermediate shaft are of cast-steel having 70 teeth, 1⅝-in. pitch, 5-in. face, and the pinions which drive these wheels have 17 teeth each.

The bedplate is composed of steel girders, the outside girders being 10 in. × 4½ in. × 30 lb. per ft., and the two inner girders 10 in. × 6 in. × 45 lb. per ft., whilst the end channels are 10 in. × 3 in. × $\frac{7}{16}$ in. thick; the whole of these girders are secured by suitable angles, riveted on one side only, the other sides being secured by five turned-steel bolts in each case. This arrangement enables the gear to be readily taken to pieces for shipment and re-erection when it gets to the mine.

The gear is driven by one of Scott and Mountain's semi-enclosed series wound electric motors, running at a speed of 500 r.p.m. when supplied with current at 500 volts, at the terminals. The motor is constructed to give a continuous output of 45 B H.P. for six hours, but will easily work up to 70 B.H.P. for one hour with a temperature rise not exceeding 70° F. above the surrounding atmosphere.

The motor is fitted with an extra heavy shaft, which is supported by Messrs. Scott and Mountain's latest design of self-oiling bearings. This motor is started and stopped by means of the liquid controller shown in the illustration, the latter being fixed in such a position that the attendant can readily work both it and the clutch gear, &c., and with it the speed of the motor can be reduced to about half speed for short periods, if required.

In addition to the above electric winding gear, we understand that Messrs. Scott & Mountain, Ltd., have similar gears in hand for the Mickley Coal Co., and also for the Dunston Garesfield Coal Co., both of Newcastle, so that we may expect in the near future to see this type of winding gear superseding to some extent the existing steam winding engines at collieries. The firm have nearly completed the erection of their new works at Gateshead, and in a few months' time will be in full swing.



Electric Winding Gear for a Spanish Mine.

Plymouth Electric Lighting.—The T.C. has reduced the price of energy supplied between midnight and 6 a.m. to 3d. per unit, with 10s. per quarter for meter, and a reduction of ½d. per unit has been made for energy supplied to private consumers for power purposes, with charges of from 1s. to 5s. per quarter for meters.

MORE ABOUT ELECTRICAL DEVELOPMENT IN CANADA.

(*Concluded from page* 244.)

Mr. Fedden's report continues:—

The third Montreal station, which is situated 84 miles away, is owned by the Shawinigan Water and Power Co., who are under contract to deliver to the sub-stations of the Montreal Co. a supply equal to 5,000 KW. To enable the owners of the power works to do this, special apparatus has had to be installed to bring the frequency into line with that used in Montreal. Three aluminium lines have been erected to transmit the current over this great distance at a pressure of 50,000 volts. In addition to the water-power plants the Montreal Co. have several steam plants in the city which are kept in reserve in case of break-down. These plants are capable of producing from 6,000 to 7,000 KW.

There are five sub-stations in Montreal, the three principal ones being tied together by means of a 2,200-volt tie line. At these three sub-stations the energy received from the generating station is transformed and converted to alternating current at 2,400 volts 63 cycles, two or three-phase. Besides the supply to Montreal the Shawinigan Works deliver electrical energy to other towns and villages.

The system adopted is that for distances of from 2 to 20 miles from the station, current is conducted from the bus-bars through oil switches to step-up transformers, where it is converted to 25,000 volts three-phase, and thence by overhead lines to the required points. For greater distances the current is taken from the bus-bars through oil switches and transformers to be converted to 50,000 volts three-phase.

A novel feature with regard to the heavy transformers which are in use is that they are placed on small trucks and wheeled to their position, thus obviating the necessity of a crane in the transformer room, and leaving overhead clear for the carrying of the high-tension wires. These transformers are of the oil-insulated water-cooled type, and have a rated capacity of 1,110 KW. Very complete arrangements are provided for the prevention of damage to the overhead transmission lines by lightning.

McGill University, Montreal.—At the McGill University, Mr. Fedden was very much impressed with the excellent lay-out of the electricity department, where all the latest up-to-date appliances are provided.

Students enter the University for a four years' course; the first two years are given to the mathematical side, and the last two years are spent in the workshops, where they are engaged in practical work.

A most interesting feature in the dynamo laboratory is that none of the machinery is permanently fixed, but it is so arranged that it can be readily moved, and by means of a small hand crane can be taken to any desired point, and in this way any combination of plant can be made for the purpose of any particular experiment with the utmost ease and a minimum of time and trouble. Separate laboratories are provided for the study of machinery for generating alternating and direct current. All the machinery is driven by electric motors, which derive their supply from the University central station. In the workshops a party of three or four students, in charge of a professor, is supplied with a motor, a generator, and a separate source of supply, together with the necessary apparatus for controlling that particular supply, and in this way each group of students is enabled to work entirely independently of the others. Another part of the electricity department is equipped with special apparatus for testing meters, transformers, fuse wire, &c., at all voltages and various frequencies. In a specially built fireproof room means are provided for the study of alternating current at very high pressures, viz., up to 150,000 volts, and Mr. Fedden agrees that this

is a very necessary part of the tuition, considering the high pressures that have to be dealt with in that country.

Canadian Pacific Railway, Montreal.—Mr. Fedden visited the repair shops of the Canadian Pacific Railway, which are constructed on a very extensive scale, and occupy a ground space of over 200 acres. All the machine tools, cranes, exhaust fans, foundry blowers, and, in fact, everything, with the exception of some hydraulic apparatus in the boiler shop, is driven by electricity, which is supplied from the works power house. This power house contains three 750-H.P. and one 375-H.P. cross-compound horizontal Corliss engines, direct coupled to three 500-KW. and one 250-KW three-phase 600-volt alternating-current generators, and two 250-KW. direct-current dynamos at 250 volts for the crane motors.

The boiler house is equipped with five Babcock & Wilcox boilers, with induced draught and connected to a steel chimney, 70 ft. high, economisers, feed water heaters, ash hoists, and all other apparatus used in an up-to-date boiler house. The power house supplied energy for some 200 motors, varying in power from 10 to 50 H.P., 400 arc lamps for illuminating the yard and workshops, and 3,800 16 C.P. incandescent lamps. Extensive arrangements have been provided for heating the workshops in the winter and cooling them in summer.

The heating is carried out on the hot-air system, and steam is supplied for this purpose from the power house through a service of pipes which are laid throughout the works.

Canadian General Electric Co's Works, Peterborough.—The General Electric Co. own some large and important works in this town, and it is here that some of the largest generators in the world are at the present time in course of construction; when completed they will each be capable of developing 8,000 KW.

The power for driving the various machines in the works is derived from their own power station, about six miles distant, which transmits about 1,500 H.P. for this purpose. The current is generated at 6,600 volts three-phase.

Electrical Equipment of Canals.—The lighting of canals and the operation of the various devices at the locks and swing bridges by electricity is carried on very extensively in Canada. The following is a short description of the electrical equipment of the Soulanges Canal—14 miles long—joining the St. Francis and St. Louis Lakes, which is typical of the system generally adopted. Artificial lighting is obtained along the canal banks by 2,000-C.P. alternating arc lamps of the enclosed type, which are placed 480 ft. apart on one side, and when nearing locks or bridges they are erected considerably nearer and on both banks. By this means navigation can be carried on with ease and safety during the night. Altogether 219 arc lamps are used along the canal. The supply is obtained from their own power house, situated five miles from the Lake St. Francis entrance of the canal. At this point the Grease River crosses underneath the canal in a 10 ft. culvert and empties into the St. Lawrence. The water for the turbines is taken from the canal, the Grease River forming the tail race. The head of water obtained is about 20 ft. The canal is crossed by seven bridges, which weigh about 100 tons each. The electrical apparatus for operating these bridges consists of a gear and friction mechanism driven by a 2-H.P. 220-volt three-phase induction motor, placed in a cabin at the centre of the bridge. By a simple movement of a lever in one direction the bridge can be started, or it can be stopped or retarded by a motion of the same lever in the opposite direction. A 3-H.P. induction motor is geared to a friction mechanism for operating the locks and sluice gates, which involves the same principle as that described for operating the bridges. The gates are closed or opened by means of a strut or drawbar hinged to the gate under the gate platform, at the end of which is a rack and pinion mechanism worked by the friction apparatus. The whole machinery is placed in a watertight cast-iron box, which projects about 15 in. above the coping of the lock. At each lock there is a switch cabin which contains two sets of transformers for stepping down from 2,200 to 220 volts, which is the motor voltage. One main switch controls all the motors at each lock.

The electrical equipment of this canal has now been in operation for upwards of two years, and during this time it has worked remarkably well, and has given entire satisfaction. Mr. Fedden says:—"I think this is one of the best applications of electrical energy I have ever seen; the change to this system increasing the working capacity of the canals very greatly, besides effecting a large saving in manual labour."

Quebec (population 63,100).—The power development of the Quebec Railway, Light and Power Co. is situated on the Montmorency River, some 7 miles from the City of Quebec. There are five turbines installed in the power house, each having a capacity of 1,000 H.P. under a head of water 200 ft. high. At an official test, one of these turbines at half gate gave an efficiency of 78 per cent. Each horizontal turbine shaft is coupled directly to the generator shaft.

The generator equipment includes three 600-KW. and one 720-KW. two-phase 66-cycle 5,500-volt alternators and one generator delivering 550-volt direct current from one end, and two-phase alternating current at the other. Two direct current generators are separately driven for excitation purposes.

The transmission line is suspended across the St. Charles River from two iron towers 150 ft. in height. Lightning protection is afforded by means of barbed wires and lightning arresters.

The sub-station in Quebec is equipped with ten water-cooled and four air-cooled oil transformers. These reduce the voltage from 5,500 to 2,000 volts. The electrical current is used for lighting and railway service. The charges at Quebec for 40 H.P. and upwards are £4 per H.P. per annum, for use from 7 o'clock at night till 6 o'clock at night, power consumers having to guarantee to disconnect for one hour during the peak load.

Ottawa (capital of the Dominion, population 62,000).—The equipment of the central station at Ottawa includes three generating sets of 750 KW. each, with provision for a fourth set. The generators run at 180 r.p.m., and produce two-phase 2,300-volt 60-cycle alternating current. They are directly connected to turbine sets mounted on the same horizontal shaft as the generator. The working head is 25 to 28 ft.

The direct current power at 500 volts is supplied through a rotary converter, and the street arc lamps are operated by current from six multi-circuit generators driven in pairs by directly coupling to two-phase induction motors. The city boasts that it is the best lighted place of its size in North America, and this certainly is no idle talk, as there are over 500 arc lamps in the streets. The price charged for power is $13 per horse-power. Water power in Ottawa is $15. There is a separate power station for the generation of electricity for street railways in this city. The district surrounding the City of Ottawa is well provided with water power, and it is estimated that the falls are capable of developing something like 1,000,000 H.P., so that Ottawa will undoubtedly become one of the chief manufacturing centres in the Dominion of Canada.

Mr. Fedden visited the Chaudiere Falls where power is obtained for several important industries. At Messrs. Eddy's match factory they turn out 35,000,000 matches daily, the largest output in the world. Pails and tubs are also manufactured here, and these articles are turned out at the rate of between 3,000 and 4,000 each day. Constant employment is found in these works for 2,500 hands.

This factory, and also a lumber mill and a large paper factory, were visited. These all work with the cheapest possible power—in fact, pay almost nothing for it—and "it is significant of the competition with which we in England have to compete. One man in a small way of business, who had a little water-power, told me that he was manufacturing boxes, and had orders ahead to keep him going for more than a year to supply his wares to Manchester and Birmingham, which he had secured in competition with all the rest of the world."

THE CONDUIT LINES OF LONDON AND NEW YORK.

THE following is a copy of a memorandum prepared towards the end of last year by Mr. J. Allen Baker (chairman of the Highways Committee of the L.C.C.) on the working of the conduit tramways in New York:—

In compliance with the request of the Committee, I have pleasure in submitting the following particulars with regard to the working of the conduit system of tramways in the City of New York. No other system of mechanical traction is allowed on Manhattan Island (New York proper), but the overhead system still prevails in Brooklyn and the outlying districts north of Manhattan, and also in Jersey City. Both the cable and the trolley lines within the City have been converted to electric conduit, and also many of the "cross town" horse lines. The original cost of constructing the Broadway cable lines was £100,000 per mile of single track. A considerable number of horse lines still exist, but many of these are now under reconstruction.

Originally there were over 40 independent street car companies in New York, but now the entire system is operated by "The New York City Street Railway Co.," which has absorbed "The Metropolitan Street Railway Co.," "The Third Avenue Co.," and the other smaller companies.

The lines traverse the most densely populated districts, and the traffic and earnings exceed those of any other street railways in the world. The first conduit line, 3 miles in length, was laid in Lennox Avenue in 1894, and it proved so efficient, reliable and economical in operation that the extension of the electric conduit system was decided on, not only for all new lines, but also in place of the cable system, in comparison with which it showed an economy in operation of at least 5 cents per car-mile. No printed report is published by the company, but the chief engineer, Mr. M. G. Starrett, very kindly furnished me with particulars of the working of the lines during the last financial year. Some of these, in comparison with corresponding figures on the Council's South London conduit lines, will, I think, be of interest to the Committee.

In all there are now 210 miles (counted as single track) of conduit lines in New York, compared with the 185 miles of tramways (also counted as single track) in the County of London, of which 156 miles are owned by the Council, while 29 miles still remain to be purchased, the last falling in in 1911.

A universal 5-cent fare (2½d.) is charged, but as the transfer system prevails (entitling a passenger by the payment of one fare to a continuous ride over two or more lines), so large a proportion of passengers take advantage of it that the average fare per journey is reduced to 3½ cents, or very slightly more than 1½d. A single fare under this system may be made available for a distance of 15 miles. The Council's highest fare is 3d., for a distance of 6½ miles, and the lowest ½d., for a maximum ride of about a mile, the average distance for a ½d. fare being two-thirds of a mile. Moreover, a system of workmen's tickets peculiar to London is in force, the charge being 1d. per single journey for any distance, and 2d. for a return journey, the return ticket being available on the same day. This privilege is very extensively used. The average fare on the Council's tramways is, for these reasons, thus only about ·93d.

In New York the average speed on all the lines is 10 miles per hour, the great amount of traffic on Lower Broadway and many of the "down town" cross lines tending to bring down the average.

For those streets even a less speed is attained than is possible in the case of the busiest thoroughfares traversed by the Council's electric lines, whereas on the more open "up town" streets a higher speed is attained than is permitted by the Board of Trade in London. The average of 10 miles in New York compares with an average of about eight miles in London.

On the Broadway, Fourth Avenue, and some other lines a headway of 15 to 20 seconds is maintained for several hours in the busy part of the day. Both of the lines specially mentioned are intersected in the city by very busy lateral thoroughfares, and pass for some portion of their route through streets so narrow that vehicles standing by the kerb have to be passed with great care. The result is that a large number of accidents occur, especially collisions with vehicles, and the amount and nature of the claims on account of accidents are greater, in proportion to population and mileage, than is the case in London.

The following figures with regard to the earning power, &c., of the New York lines are important:—

The average earning power per car-mile is from 33 to 34 cents, or 1s. 4½d. to 1s. 5d. (dollar at 4s. 2d.).

The operating cost (including maintenance, repairs, renewals, accidents, &c.) per car-mile is from 14 to 15 cents, or 7d. to 7½d., making a net profit per car-mile of about 19 cents, or 9½d.

The company has about 3,000 cars in use, all single deck, but many of these are open or "summer" cars. An average of 1,600 cars were in daily operation during the year under review, and 52,014,109 car-miles were run; this mileage, for the 210 miles of track in use, at 19 cents, gives a profit for the year of $9,882,680 (say, £2,058,892), an average of £9,804 per mile of single line.

The cost of construction of the New York conduit lines averaged from $100,000 to $125,000 per mile of single track; this cost, including all the conduit work, tracks, earthenware ducts for the feeder cables (but not the feeder-cables themselves) works out at an average of about £22,500 per mile, as compared with £13,800 per mile of single line, the average cost in the case of the South London conduit construction, plus £1,000 extra for the earthenware feeder-cable ducts, making £14,800, as compared with £22,500 in New York.

The cost per single mile of the feeder-cables used on the New York system is about $16,000 (that is practically £3,200 per mile of single track, as compared with £1,500 in London).

The power stations and sub-stations, together with their equipment, cost per mile of conduit line installed, about $29,000 (that is about £5,800, as compared with the estimated cost for London of £5,850). This comparison is indicated in the table included later in this report.

The cost of cleaning the conduit averages $500 per mile of single track (say £100), compared with £134 per mile included in the estimates for the Council's tramways for the current year; 160 men are employed for conduit cleaning in New York on the 210 miles of track.

Scrapers are used to carry away the dirt in the conduits between the manholes, and no caked mud is allowed to accumulate at the bottom of the conduit. The insulator holes are placed 15 ft. apart, and through these the cleaners clean out the conduit daily as well as through the manholes, or sumps, which are placed 100 ft. apart. One of the greatest difficulties experienced in New York is the maintenance of the service during the severe winter weather, when snow may accumulate and ice freeze at the bottom of the conduit. Further, in times of very severe frost, an occasional difficulty has been experienced in straight track work, the track rails being forced inwards, and in their turn forcing the slot rails inwards, and so decreasing the width of the slot opening along which the plough passes. These are difficulties which are not likely to occur in London. Mr. Starrett expressed the opinion that the climatic conditions of London are much more favourable than those of New York for the operation of conduit tramways.

Notwithstanding these special difficulties, the "trouble" items on the conduit lines are considered to be no greater (if as great) as on the trolley lines outside the City limits, while the operating expenses, including maintenance, repairs, and renewals, when the greater life of the conduit work is taken into account, is considered to be in favour of the conduit system.

In New York the day's work of motormen and conductors consists of 10 hours' labour out of 12 consecutive hours. The motormen receive a minimum wage of $2.10, and a maximum wage of $2.50 per day, for a full day's work. For the first year, $2.10 (8s. 8d.); for the second year, $2.25 (9s. 4d.); for the third year, $2.35 (9s. 9d.); and for the fourth and fifth, and after the fifth year, $2.50 per day (10s. 4d.). The rates of pay of the conductors are as follow:—First year, $2 (8s. 3d.); second year, $2.10 (8s. 8d.); third year, $2.20 (9s. 1d.); and after the fifth year, $2.35 (9s. 9d.).

Conduit cleaners are paid $1.75 (7s. 2d.) for 10 hours' work.

Car cleaners receive from $1.50 to $1.75 (6s. 2d. to 7s. 2d.) for a day of 10 hours, according to their work and length of service. They are supposed to work seven days per week, but in practice every man is off duty on alternate Sundays.

The greatest care is exercised in the selection of the motormen, as the safe and economical working of the system depends on their skill and efficiency. Every applicant has to pass a severe examination, including tests for eyesight, hearing and colour blindness. After an examination for this purpose, he enters the "school," and upon the certificate of the "instructor" he is first placed upon streets having the least traffic until he is considered competent to take charge of a car on a more crowded street. Of the men who pass the physical examination, only about 40 per cent. finally qualify as first-class men. Neither motormen nor conductors are permitted to sit while on duty on the cars. This is also the rule in all the large American and Canadian cities. It is not considered possible for the motorman to operate electric cars with safety in town traffic unless he is in a standing position.

Table of Comparison between the New York and London County Council Conduit Systems.

—	New York. 210 miles (single track).	London. 54 miles (single track).
Average gross earnings per car-mile.	1s. 4½d.	1s.
Average operating cost per car-mile, including repairs, renewals and reconstruction, maintenance, accidents, &c.	7½d.	Estimate without renewals, 7d.
Average cost per track-mile for conduit cleaning per annum.	£100	Estimate for current year, £134
Average cost of constructing conduit line per car-mile of single track, including cable ducts, but not cables.	£20,000 to £25,000	£14,800
Average cost of feeder cables per mile of single track.	£3,200	£1,500
Cost of power station and sub-station per mile of single track.	£5,800	£5,850*
Average speed at which cars run.	10 miles an hour.	8 miles an hour.
Hours of motor-men and conductors.	10 hours' labour (in 12 consecutive hours).	10 hours' labour (in 12½ hours average)
Pay of motor-men per day ...	8s. 8d. to 10s. 4d.	4s. 9d. to 6s. 3d. (74 per cent. at 6s. 3d.)
Pay of conductors per day ...	8s. 3d. to 9s. 9d.	4s. 9d. to 6s. 3d. (65 per cent. at 6s. 3d.)
Pay of conduit cleaners per day	7s. 2d.	5s. 4d.
Pay of car cleaners per week	£2 3s 5d. to £2 10s. 6d.	£1 5s. to £1 7s. 6d.

* This figure is based upon obtaining power from the Greenwich generating station, and with 1,000 cars in operation over 200 miles of single track.

It will thus be seen that the constructional costs in New York are about 50 per cent. higher than in the case of the Council's tramways, this being probably accounted for by the facts (1) that some portions of the conduits had to be excavated through solid rock; (2) that an extended and more expensive form of yoke is used than in London; (3) that all labour and materials are dearer in New York than in London; and (4) that the pipe obstructions are greater than those met with in the reconstruction of the Council's lines.

The construction of all the New York conduit lines has been carried out by the operating company itself, without the intervention of a contractor.

It will be noted that under the head of "cost of operation" in New York, the figure of 7½d. per car-mile includes all renewals and reconstruction of lines, rolling stock, &c., and no sum has therefore to be set aside for this purpose.

On the Council's lines the present estimates (with labour 50 per cent. lower than New York) show an operating cost from the Greenwich station of 7d. per car-mile, and it is also proposed to set aside a further 1d. per car-mile as a "renewal reserve fund."

The average life of "special work" is given for New York at five years, and that of straight track ten years, while the traffic on the lines is much heavier than in London. The average estimated life of "special work" and straight track on the L.C.C. lines is fixed at an average of seven years.

Among the important advantages, in a city like New York, of the conduit over the trolley are considered to be (1) the greater sightliness; (2) the absence of danger from live wires in the streets; (3) immunity from danger of electrolysis to water and gas mains, owing to insulated conductor bars in the conduit, instead of rail returns as in the case of the trolley system; (4) greater durability of construction, the conductors and insulators in the tube lasting, probably 30 years as compared with three or four years for overhead wires; (5) no loss of current by bad contacts, greasy rails, or imperfect bonding of rails, and, consequently, no disturbance to observatories where magnetic observations are carried on.

Similar advantages will, no doubt, be experienced in London as are found, by experience, to obtain in New York.

The comparisons with the New York "cost of operation," and "life of plant," &c., are of more value to London than the earnings; the average fare being so much higher in New York than in London, and other special circumstances as above indicated operating.

At the same time it shows with what remarkable economy a complete conduit system in a large city like New York can be operated, and indicates that a slight readjustment of the Council's present fares, or the stages now given for a ½d. or 1d. fare, would add materially to the earning power of the lines.

J. Allen Baker.

Ormskirk Electric Lighting.—The U.D.C. has decided not to sign the agreement with the Construction Co. until the question of a refuse destructor, to be worked in conjunction with the electric installation, has been settled.

THE FUTURE OF RAILWAYS.

By PHILIP DAWSON.

(*Continued from page* 242.)

THE distance that a business or working man can live from his work is a function of three variables :—

1. The time taken to cover the distance.
2. The cost of the journey.
3. The frequency of the means of transit.

The last condition is of considerable importance, as few men can risk the possibility of having to wait an hour or more should they happen just to miss a train. Consequently most workers in London do not venture to live much over four or five miles away from their work. Even for short distances of from 5 to 10 miles, the time sometimes taken by local trains is simply appalling, as shown by the study of the local time tables of most of the railway companies. These show that there are many trains on suburban lines which average under eight miles an hour, over the same lines where other trains average nearly 20, whilst electric trains could in some cases average up to 30 miles an hour.

A good, cheap and frequent service between the town and the suburbs would also induce a considerable amount of travelling on the part of the female and juvenile part of the family. If they can get to one of the big shopping centres of London and return, say, between breakfast and lunch, or between lunch and dinner, without the bother of hunting up elusive trains in a time table which is never to hand when wanted, they are certain to avail themselves of this privilege. The traffic that would grow up as a result of giving proper facilities in this direction is not clearly realised by the railways. Here again the frequency of the service is a most important point, because otherwise the superior speed of the train as compared to that of the tramways would often be more than counter-balanced by the time wasted in finding out a train and then waiting for it.

Not only would a large shopping traffic be built up by this means, but a very considerable number of people would come into town in the evening to visit theatres and other places of amusement, if only it were more easy to do so.

ELECTRIC TRAMWAY COMPETITION.

That the competition of electric tramways has already been keenly felt by the railway companies is shown by their half-yearly reports, a few extracts from which may, perhaps, not be without interest. The result of this competition has been to cause the Lancashire and Yorkshire Railway to electrify its line from Liverpool to Southport, and the North-Eastern to apply electric traction to its suburban lines running out of Newcastle.

The following are a few extracts from the half-yearly reports, as far back as early in the year 1903 :—

North-Eastern Railway Co.'s Meeting, February 13th, 1903.

Viscount Ridley (chairman) stated: There has been a total decrease in the passenger receipts of 2·55 per cent. They attributed the falling off in these receipts, to the extent of about one-third, to the competition of tramways in the neighbourhood of Newcastle and Gateshead, and in order to meet the loss they decided to electrify about 37 miles of railway in that neighbourhood. They believed that in this way they would be able to give more frequent and more elastic services to the public, and be able to show more economy over locomotive working.

Great Central Half-Yearly Meeting in Manchester, Wednesday, February 11th, 1903.

Sir Alexander Henderson, M.P., presided: There has been a considerable falling off in the short-distance journeys owing to the competition of the Manchester and Grimsby electric tramways. They estimated that the amount of passengers lost to them by the tramway competition referred to was 330,000 odd, and the revenue £2,350.

Lancashire and Yorkshire Railway Co.'s Meeting at Manchester, Wednesday, February 11th, 1903.

Sir George Armitage presiding: The total number of passengers carried showed a decrease of 538,529, or 1·62 per cent.; they had a considerable decrease in the number of passengers carried, but an increase in receipts. That was entirely due to the fact that the tramways had taken a great many short-journey passengers, but they had been endeavouring to encourage passengers to take longer journeys.

Great Western Railway Co.'s Meeting, Thursday, August 13th, 1903.

Earl Cawdor presiding: We have a great deal of competition in the neighbourhoods of Birmingham and London by tramcars, and we have had to reduce our fares in these districts in order to maintain our traffic. He also referred to the electrification of the railways between Hammersmith and Bishop's Road then proceeding; for this it was proposed to erect a station at Park Royal, in which provision was also being made for the supply of current for electrically lighting the works at Paddington.

North Scotland Railway Co.'s Meeting, September 10th, 1903.

Dr. William Ferguson presiding: The competition of electric tramways in the neighbourhood of Aberdeen has cut into the company's receipts for suburban trains; and the new suburban tramways near Donside, on the one hand, and Deeside as far as Culter, on the other, will prove a serious rival.

These reports indicate what was the state of affairs in 1903. At the present moment the competition is still keener than it was then.

Some very interesting and instructive results have been obtained in America on the Albany and Schenectady electric line. The two towns are about 15 miles apart, and are connected by the New York Central Railway which gives a very good service, and the stations are located in good central positions. The electric road was put into operation in September, 1901. The road is double track, and both in Albany and Schenectady the cars run on the existing tramway systems. For the greater part of the day there is a regular half-hourly service, but during the busy hours of the morning and afternoon this is increased to a 15 minutes' service. Between midnight and 5 a.m the cars run every two hours.

When first started the line carried 76,000 passengers per month, but it is now carrying 150,000 passengers per month. The traffic on this line is a striking example of how such traffic can be created by supplying proper travelling facilities, for before the advent of the electric line, the steam railway only carried 20,000 passengers per month. It also shows the disastrous effect of such competition, for at present the steam line only carries 10,000 passengers per month.

A study of the passengers carried on the surface lines in and around New York City is of great interest, as it shows that as long as the surface lines were operated by cable or by horse, their annual increase in traffic, when there was any, was proportional to the increase in traffic of the Manhattan Elevated steam roads; then came the period of electrification of surface lines, and from that moment the increase in their traffic was something phenomenal, the total number of passengers carried rising from 260 millions to 509 millions between the years 1895 and 1900. During this period the traffic on the Manhattan Elevated declined, and then remained practically stationary up to the time that it was electrified. From that time onward there has been a steady increase, the number of passengers carried showing a growth very similar to the rise in traffic on the surface lines after they were electrified.

The trouble from competing electric tramways which is now being experienced by the railway companies in this country has already been felt in America, and, after repeated unsuccessful attempts on the part of the railroad companies to prevent the granting of franchises to the competing electric tramways, they have had to abandon these obstructive tactics, and either to purchase and operate the electric tramway lines themselves, or to consider the electrification of their own railways along those routes where tramway competition is most severe.

THE EFFECT OF ELECTRIC TRACTION.

In order to organise a train service properly, terminal facilities are required which at present are not generally available where steam is used. The introduction of electric traction should more than double the capacity of termini, and would enable a much more frequent service of trains to be arranged, as well as a much higher rate of speed to be obtained.

It may be pointed out that with a given size of train, the actual carrying capacity of the line, *i.e.*, the number of passengers that can be removed from a given point in a given time, depends only on the frequency of the service, and not on the speed of travel. It is also well to call attention to the fact that the number of trains in service at any particular moment during the day is no measure of the capacity of the service, because, with a given interval of time between trains, the number of trains in service will

be inversely proportional to the speed—the higher the speed the fewer trains in service. The use of electric traction increases the carrying capacity of a line almost entirely by reason of the more frequent service which is thereby rendered possible, partly by the time saved in termini by dispensing with the changing of locomotives, &c., and partly because the greater speed of the electric trains enables them to run at closer intervals of time, without reducing the actual distance between consecutive trains.

With the present steam service there is always delay in getting the trains out of the terminus after they are once in, and consequently, if a train is late in arriving, it is also late in departing, thus tending to delay the next train, which may be up to time, but unable to enter the station because there is no room. The lateness of the first train allows time for those passengers who would ordinarily have travelled by the second train to collect on the platform before the first has gone out. Hence the latter carries the total number of passengers which should have been divided more or less evenly between the two trains, and the second train may quite possibly run comparatively empty. Thus not only is one train overloaded, and the next one comparatively empty, but there may be a dangerous rush to secure seats in the former.

With double-ended electric trains, much, if not all, of this trouble could be avoided. In the first place, the electric train, owing to its superior powers of making up time, would be less likely to be late. Secondly, if it was late, it could, being double ended, leave the station in a very short space of time after its arrival, and so not delay the following trains. The late arrival of any kind of train must necessarily involve a bigger crowd of passengers than the normal amount, but this evil would be considerably mitigated by the prompt departure of the train and by the public being aware that another train would start almost immediately. Most of our railway companies apparently have not as yet thoroughly realised the immense value to them of their suburban business, and how readily the gross profit supplied by this service could be doubled or trebled by adopting methods similar to those which have been adopted in the case of American Elevated or London Tube Railways.

The greatest hope of our railway companies lies in increasing the number of passengers, and apparently everything is being done to increase long-distance traffic, though very little has hitherto been done to increase suburban traffic. It is to the latter that we should look for increase in receipts, but, owing to the small average fare paid by suburban passengers, the traffic will have to be enormously increased in order to make any appreciable increase in the net receipts, and the only method whereby the requisite increase in carrying capacity can be obtained is through electricity. This, to all intents and purposes, will double the carrying capacity on local lines, and will permit of the train mileage being considerably increased without a proportional increase in the cost of haulage.

The results obtained on the City and South London Railway, and also on the Liverpool Overhead Railway, have demonstrated that large volumes of traffic can be expeditiously and economically handled by means of electric trains. These two are especially mentioned on account of the long time during which they have been operating. They were the pioneers of electric traction, but have stood the test of long and continuous operation, and thus amply demonstrate the benefits of electric traction.

In considering the introduction of electric traction on suburban lines, it must be borne in mind that the capital burden of most of our railway companies is not relatively as heavy as that of the tube lines, even if one takes in to consideration the expenditure which would be required to electrify all suburban lines. Hence they should in many cases certainly be able to make a better capital return on their systems than is possible on the tubes, which have nothing like the same amount of traffic. Furthermore, as has already been pointed out, people will not usually use a tube line in preference to a surface line where the latter is available.

There is every reason to expect that electricity will bring a large additional volume of new traffic, and at the same time reduce working expenses. The average receipts per passenger on some London steam and electric lines are as follows :—

Metropolitan railway	1·78d.
Metropolitan District railway	1·84d.
East London railway	1·47d.
North London railway	0·93d.
Central London railway	1·90d.
City and South London railway	1·87d.
London Brighton and South Coast suburban system (estimated)	2·00d.

With steam railways there is a tendency towards carrying fewer passengers per train, and, generally, the proportion of occupied to unoccupied seats seems to be diminishing.

To show how low are the average speeds of suburban trains travelling up to London, figures given by Mr. Edgar Harper before the Royal Commission may be quoted. These figures show that the highest speed is that of the Great Eastern, which is 19·6 miles per hour. The average speed of suburban trains is, however, much nearer to 15 miles an hour. In this connection it should be noted that the average given is really higher than it should be for a proper comparison between steam and electric service, as with the latter all the local trains would be stopping trains, that is, stopping at all stations. If the average speed of similar trains were taken, omitting those trains which run through several stations without stopping, it would be found that the average speed would be very much lower than that given, in many cases, probably not much over 12 miles an hour. This statement can easily be verified from the local time tables of railway companies, which show how very low is the average speed of stopping trains on most suburban systems, and what a long time a passenger would have to wait in some cases if he just missed a train.

The probable competition resulting from the electrification of the various tramways now under construction, and for which Bills are being sought in and round our large cities should cause railway companies to think seriously about the future, but it should be noted that if the railway companies will take proper precautions the public will undoubtedly support them. One reason for this, as regards London, is the great crush that is to be seen at all tramway termini, such as Westminster Bridge, Blackfriars Bridge, &c., where, for a couple of hours during the rush hours of the evening, hundreds of people have either to be turned away or to wait, possibly in the wet or cold, for their turn to get into a tramcar. The railway company, with its station facilities and with the possibility of running trains of such lengths as to suit the rate at which passengers are flowing in, can deal with the traffic in a much more comfortable and expeditious way than the tramways can; and in this country, where the Board of Trade will not allow passengers to stand, either on the platforms or inside the tramcars, overcrowding will not be possible, which fact should be in favour of the railway companies after electrification.

One of the universal results of the development of railway travel is to shorten the average journey taken, and to lower the average fare per passenger carried. This is not due to the falling off in the long-distance traffic, but to the very large increase in the short-distance traffic; this falling off in the average receipts per passenger should not be overlooked by the railway companies, for the shorter the journey the greater the expense and the smaller the receipts per passenger carried.

In order, therefore, to increase the net receipts, it is necessary to effect on enormous increase in the number of short-distance passengers. This can be done by the levelling up and cheapening of fares which would enable workmen and clerks to undertake daily journeys, and even to indulge in pleasure excursions, the cost of which was formerly prohibitive. Furthermore, when once the habit of travel is cultivated, it is not lightly dropped, and people become so accustomed to using the trains to get to and from their pleasure as well as business engagements, that they do so as a matter of course, without thinking twice about it.

Electric traction, embodying as it does all the advantages of the latest modern technical science, means greater economy in working, and consequently lower fares than are possible with steam trains. Not only is the power used almost directly proportional to the work to be done, but since the power used on any train is not concentrated at one point, as in the locomotive of a steam train, the size of train can easily be adapted to the state of traffic, thus considerably reducing the

useless ton mileage. With the steam locomotive there is a certain minimum size of train below which it does not pay to go, and as this may provide a capacity in excess of the traffic during slack times, the frequency of the trains has to be reduced, or the cost becomes excessive. With electric traction it costs very little more to run two separate trains composed of two motor-cars and two trailers than it does to run a single train composed of four motor-cars and four trailers. The greater frequency of trains which is thus feasible is a great incentive towards travelling.

Electric traction is thus highly desirable for times of light traffic, but its chief merit lies in the rapid acceleration obtainable, and the high average speed which is thus possible.

The normal acceleration obtained on the Metropolitan District Railway steam system is about 6 in. per second per second; the best results obtained during experimental running have reached 9 in. per second per second. Mr. Holden, the locomotive superintendent of the Great Eastern Railway, states that he has obtained an acceleration of 1·4 ft. per second per second from the "Decapod" locomotives, which he has recently completed. This is doubtless a good result for a steam locomotive, but appears very small when it is remembered that on the electrically operated Liverpool Overhead Railway, with the equipments recently supplied by Messrs. Dick, Kerr & Co., the acceleration obtained reaches 4·2 ft. per second per second.

A study of the acceleration actually obtained with steam and electric trains is very instructive. Thus, whereas in 10 seconds on the Berlin Stadtbahn operated by steam, a speed of 5 miles an hour is reached, and on the present Metropolitan District with steam trains, 3 miles an hour, in some experiments carried out by the General Electric Co. at Schnectady, a speed of 30 miles an hour was reached in the same time and in actual practice on the Liverpool Overhead, a speed of nearly 19 miles an hour is attained.

The recent experiments which have been carried out to obtain rapid acceleration with steam locomotives cannot be described as successful, and the enormous weight of the engines necessary to give the required result has practically prevented their adoption in regular service. It is also important to bear in mind that though steam locomotives have been built capable of giving a starting acceleration as high as 18 in. per second per second, this rate falls off very rapidly with increasing speed. This grave defect has also been observed by engineers in Germany, where, after the most elaborate experiments, it has been admitted that rapid acceleration is impossible with steam locomotives having reciprocating parts.

As already pointed out, steam has reached its limit as regards acceleration, and where the average distance between stations is short, rapid acceleration is of the greatest importance, as it enables a much higher average speed to be obtained than can possibly be accomplished by means of steam locomotives.

The best results obtained with steam locomotives as regards acceleration average about one-third of a mile per hour per second. These figures are the average rate of acceleration, which means that for certain portions of the period the accelerations have been much greater. It is of the greatest possible importance to get a high average speed, and where stations are close together, the only method of obtaining this is by using the high rates of acceleration which electric trains make possible.

A study of the time tables of most of our railways would show that with the present facilities they have practically reached the limit of the capacity as far as local services are concerned, if steam be retained. The increase of trains which will be required is practically impossible under the present steam conditions. What electricity can do was well expressed by one of the directors of the Lancashire and Yorkshire Railway when the electric service was first inaugurated between Liverpool and Southport. He gave as his reasons for the electrifications of branch lines, that in order to cope with and handle adequately the local passenger traffic, it would be necessary to double their tracks, if they used steam locomotives, while electrification would give them the same and better results, and would cost less.

The present difficulty experienced with respect to cramped terminal space would be greatly lessened by electrification, even without any other change.

It is most important for railways to remember that though the Royal Commission on London Traffic is certain not be be in any wise antagonistic to the railways, and will not probably recommend any proceeding detrimental to them if it finds them prepared to give the proper facilities to the public, yet it may hold very strong views as to the necessity of these facilities, and if the railways will not provide them, it is quite conceivable that it may advise the granting of concessions for lines directly competing with the railways.

(To be continued.)

THE CHEAPEST FUEL.

The question of cheap fuel is one that is not sufficiently considered in this country. A speaker at a recent discussion referred to the dearness of cheap coal which contained 30 per cent. of incombustible matter, and cost 12s. per ton in carriage. It is worth while inquiring what really is the effect of dirt.

In the first place, if we have two similar coals, one clean and the other dirty, the calorific value per lb. of combustible will be equal; let this value be taken as 14,500 B.Th.U. per lb. Then of the two coals, one containing 5 per cent. of ash and the other 30 per cent., the actual heat values per gross lb. will be 13,775 B.Th.U. and 10,150 B.Th.U. respectively. The cost of carriage at 12s. per ton will be just over 12s. 7½d. for the good coal and 17s. 1¾d. for the dirty coal, each calculated per ton of combustible. Let it be assumed that the prices of the coal at the pit are 4s. and 8s. respectively. Then these values reduced to per ton of combustible become 8·422 and 5·714. Added to the cost of carriage, the cost of the coal delivered will be 21s. 1d. and 22s. 10½d. Obviously where carriage is so large a proportion of the total cost, the dirty coal is the dearer.

It is obvious from the above figures that only 7½d. per ton would be saved if the cleaner coal could be washed quite clean, and it would cost, say, 1s. per ton to do this. Hence there can be no serious economy in washing a clean coal. Its price on the clean ton would now be 21s. 5½d. It would still be cheaper than the dirty coal. Assume that it costs 2s. per ton to get rid of ashes. Then the ash per ton of the clean coal will only cost about 1¼d. per ton of coal to remove. The total cost per ton of combustible, including ash removal, will be 21s. 2¼d.

Suppose, however, that in order to save carriage the dirty coal is washed. Then per ton of washed coal its price will be as follows:—

4s. × 19/15	=	5s.	7d.
Washing, say	=	1s.	5d.
Carriage	=	12s.	0d.
		19s.	2d.

or 19s. 2½d., as against 21s. 2½d. for the dearer coal. It is worth saving this 2s. per ton of combustible if the coal is of a kind that will burn with the available conditions. The question turns largely on the cost of carriage and washing. Washing is said to cost 1s. per ton. It is set down at 1s. 6d. for the very dirty coal above.

It never pays to carry coal dirty for any distance for the sake of the dirt, even if the dirt runs to clinker and is paid for by builders. At ordinary South Country carriage rates, dirt costs 8s. to 12s. per ton, plus the labour of the fireman and the cost of removal.

The washing of coal would, of course, justify the seller in raising the price per unit of calorific value, and probably the benefit would be evenly divided between seller and buyer, for coal users find no greater nuisance than their ashes. The adoption of washing by the collieries would have a further good result, that coal now left in the pit or on the waste heap would be converted into good fuel and find a sale, and assist to put off the day when our coal resources give out, as they surely and rapidly are doing.

A dirt content of 30 per cent. is, of course, very high. Tested on a basis of 20 per cent. of dirt, a 4s. coal would

cost actually 5s. per ton of combustible. It would cost 15s. for carriage, and about 5d. for ash removal, or a total of 20s. 5d. per ton of combustible. It would, therefore, be cheaper than the clean coal at 8s., but dearer than the washed cheap coal previously named. Anyone can make the calculations for himself by first raising the price per ton and the carriage to the amount proper to the ash ratio, and adding to the enhanced price the cost per ton of coal of removing the ash produced by that ton.

Washing does not, of course, remove all ash and clinker, but it should remove slate and clay, large or small, and bring up the calorific value of the cleaned coal to its real value as combustible. Apart from the size of its pieces, clean coal, if washed, would bring a price proportionate to its actual calorific value. Any difficulty in burning it naturally tends to depreciate its value, while, on the other hand, any power plant so circumstanced that it cannot avail itself of the full range of the fuel market is exposed to the risks incidental to a narrower field of choice, and under some conditions may even find itself in a kind of fuel corner.

It need hardly be pointed out how great would be the relief to the railway traffic could all coal be washed before being carried. It is clear, however, that even on a long haul the amount saved in carriage is not so great as the cost of washing the cleaner coals. Washing, however, should expedite mining, and, perhaps, save itself in part in this direction.

B.

THE CONVERSION OF A TELEPHONE EXCHANGE FROM THE MAGNETO TO THE CENTRAL BATTERY SYSTEM.

By B. S. COHEN.

When an existing telephone system has to be converted from one method of working to another, a considerable number of important points immediately present themselves for consideration, the point of chief importance being the necessity for carrying out the conversion with the minimum of inconvenience to the telephone public.

It may be interesting to many to outline the methods which have been adopted for carrying out such a conversion.

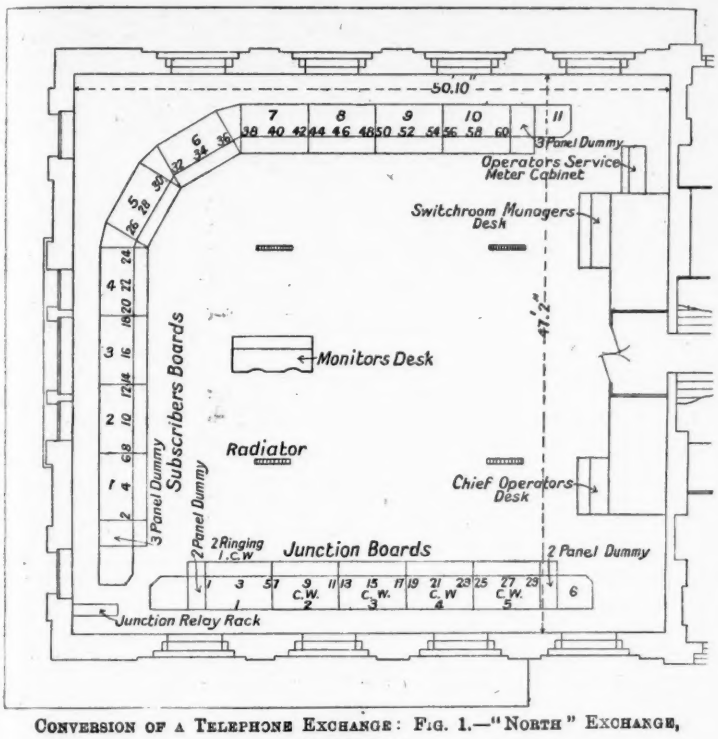
The methods to be described have been employed in the main in connection with a considerable number of large exchanges in this country.

The requirements of the new exchange as regards commencing equipment and ultimate capacity are the first consideration, and to this end the department dealing with the traffic furnishes complete records of the normal daily exchange load for the various kinds of local and junction services, and also particulars of the past rate of increase and estimated future increase in the various types of services.

From these particulars the number of lines which an operator can deal with, and the number of operators' positions required, are determined. In the conversion of a large area with a considerable number of exchanges, the design is complicated by the necessity for allowing for a lighter operator's load during the transition period when the exchanges in the area are working partly on the old magneto, and partly on the new central battery system, and the junction work is consequently more difficult than when the conversion of the whole system is completed.

The operators' load is settled on the basis of calls per busiest hour, and it is interesting to note that there is a constant ratio between this figure and the total calls per day which varies very slightly, if at all, in any one exchange.

This ratio, however, varies for different types of exchanges, and is largest in exchanges where a considerable proportion of the area served is residential, as in such cases the calls are spread well over the whole day, the morning and afternoon maxima and the lunch and early and late minima on the load curve not being so steep as in the case of an exchange in a business area.



Conversion of a Telephone Exchange: Fig. 1.—"North" Exchange, Switchroom.

The ratio of local calls to calls for other exchanges is another important particular which must be supplied by the traffic department. As illustrating the importance of this point, it may be mentioned that in many exchanges the local calls form such a small percentage of the calls for other exchanges, that the subscribers' multiple used for the former gets very little work, and in such cases it is quite feasible to economise in the number of multiple spring jacks by spreading out the multiple. For example, in a 12,000-line exchange, by making the subscribers' multiple repeat every nine panels, or 6 ft. 4½ in., instead of every eight panels, or 5 ft. 8 in., a saving of about 67,500 multiple jacks is effected, costing with labour of wiring, &c., about £2,250, and it must be borne in mind that this is effected without detracting from the commercial efficiency of the switchboard. It follows from this that if the proportion of local calls became very small, it would pay in practice to do away altogether with the subscribers' multiple. As the junction multiple on the incoming junction boards is used for every connection, the above does not apply, and indeed it is customary to reduce the number of panels per complete multiple on such boards.

The size and general design of the exchange having been settled, the selection of suitable premises is the next consideration. The situation of the exchange with respect to the subscribers depends to a great extent on the variation in the density of the subscribers in the different localities served, and is complicated to a certain extent by wayleave considerations and the physical nature of the area.

Assuming that the old exchange is in the most suitable position for serving its subscribers, the new premises would be obtained as close as possible to the existing one.

It very rarely happens that the latter can be utilised for the new exchange, and whenever possible new premises are built specially designed for the work. It is advisable to put the apparatus and accumulator rooms as near as possible to the switchroom, in order that the cables between the two

should be of a minimum length. On the other hand, the operators' dining, &c., rooms should be also in close proximity to the switchroom. In practice a satisfactory arrangement for exchange premises which is often met with would have the apparatus and accumulator rooms on one floor, the former containing the main and intermediate distributing frames, power apparatus, &c. The operators' dining, recreation and cloak rooms would be on the next floor above, and the switchroom on the top floor to allow of roof lighting.

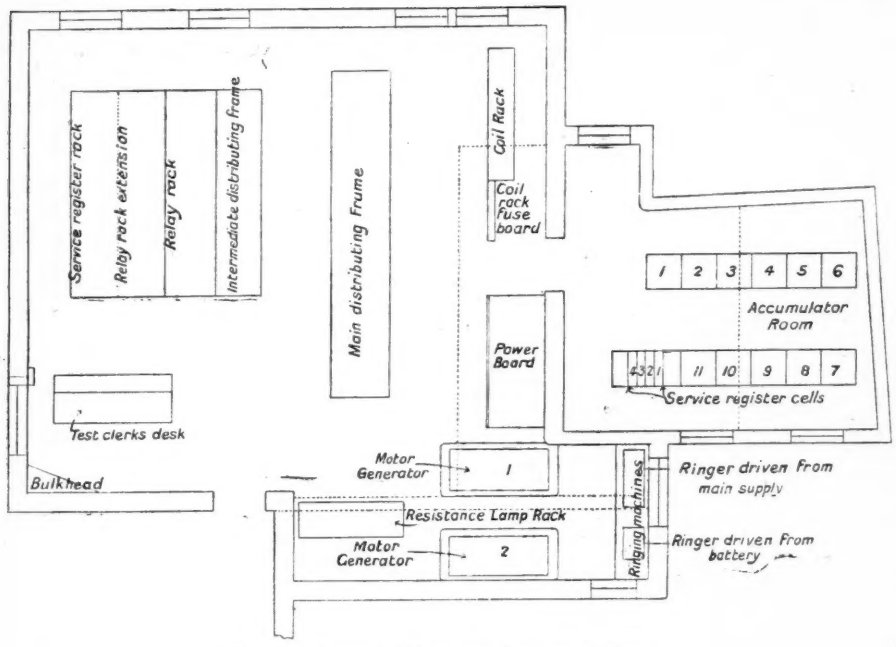


Fig. 2.—Norwich Exchange, Apparatus Room.

The ideal shape of such a building should be rectangular, with a minimum width such that a whole number of switchboard sections can be turned in the switchroom, thus avoiding the use of dummies at the bends. This is an important point, as in an exchange known to the writer the bad shape of the building has necessitated a considerable number of dummies, the capital locked up in which represents an annual revenue of several hundreds of pounds.

A plan of "North" switchroom, a new exchange of the National Telephone Co. serving a portion of the north of London, is illustrated in fig. 1. It will be seen that the subscribers' sections sweep round one side of the room and the incoming junction boards round the opposite side, both runs of boards starting from the same corner. The capacity of this switchroom is quite small, being only about 4,200 subscribers and 486 incoming junctions, but it has been selected as an example approaching the ideal arrangement. It may be of interest to mention that this exchange is built in an old chapel, at one time the property of the Sandemanians, at which it is stated Faraday himself was wont to attend.

A typical method of arranging the apparatus room is illustrated in fig. 2. This shows the method adopted at Norwich exchange. The outside lines terminate on the main frame, which also carries the lightning and stray current arresters. This frame is generally arranged to give a capacity for outside cable leads of at least 25 per cent. more than the ultimate capacity of the exchange, in order to allow for non-utilised wires in cables. This frame can be extended when necessary. The main frame has displaced the old-fashioned test board, as with the central battery system the nature of practically all faults can be determined from the multiple.

The intermediate frame cannot be conveniently extended, and is installed with the ultimate capacity. A detailed description of the above apparatus and the other apparatus shown in plan in fig. 2 is beyond the scope of this article, and readers must be referred to the articles which have appeared previously on these matters. The racks which carry the cables between the various pieces of apparatus are made of strap and angle-iron, and are carried overhead.

As a very large number of cables are required, all of which must be brought out in a certain consecutive order at both ends, the design of the racks and the arrangement of the cables demand careful forethought. An example of cable work is shown in fig. 3. This is the rack carrying the multiple cables from the intermediate distributing frame at Holborn Exchange.

The arrangement of the power apparatus is shown in fig. 2. The motor-dynamos for charging the battery are in duplicate, as are also the machines for providing 15-cycle alternating current for ringing purposes. If possible, there should be two distinct sources of power for driving the charging machines, and the ringing motor-generators are driven generally one from the main supply and the other from the battery.

Fig. 3.—Holborn Exchange, I.D. Frame and Cable Rack.

The accumulator room contains the main 11-cell battery and the smaller 4-cell battery, which acts as booster for the service registers—*i.e.*, call-recording meters. The main battery should be provided with sufficient plates to hold about a two days' load for the first three or four years' life of the exchange, and the tanks with room enough to take plates for the ultimate capacity of the exchange.

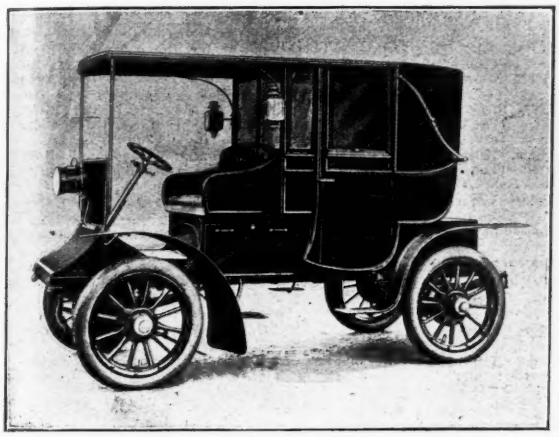
The power apparatus is generally so designed that one of

the charging machines, running for two or three hours in the morning and afternoon at the peaks of the day load, keeps the cells full, besides which they are given a weekly "milking" to keep them in good condition.

(To be continued.)

THE OLYMPIA AUTOMOBILE EXHIBITION.

This, the third International Exhibition of the Society of Motor Manufacturers and Traders, which is held under the auspices of the Automobile Club of Great Britain and Ireland, was opened on February 10th at Olympia.



The Silvertown Double Landaulet.

It must at once be granted that the show is in every way a representative one, gratifying alike in its new situation, which is more accessible than the Crystal Palace, in its excellent organisation, and in the exceedingly attractive manner in which the £700,000 worth of motors and accessories are displayed. In fact, the very successful *début* of the first Olympian show quite justifies the sanguine expectations of the promoters in seeking a more convenient venue for their exhibition. The latter is thoroughly International, space having been allotted by ballot, in which home and foreign makers and agents shared equally.

The great hall is practically all devoted to motor-cars, the gallery serving for accessories, while in the annexe a fine display of motor-boats and launches is on view.

It is impossible, in the space here available, to do more than briefly notice the prominent features of the exhibition generally, with special mention of matters more intimately connected with the electrical trade.

Taken as a whole, the petrol exhibits, which quite over shadow all other types, show their greatest advance in the comfortable and, in many cases, luxurious carriage bodies provided for pleasure vehicles. This is true of so many prominent exhibits that it would be invidious to mention any maker specially. It is also noticeable that the White Steam Car, the well-known and highly successful pleasure type of vehicle, is the only exhibit of this class of car, although the heavy steam car for industrial purposes is much in evidence.

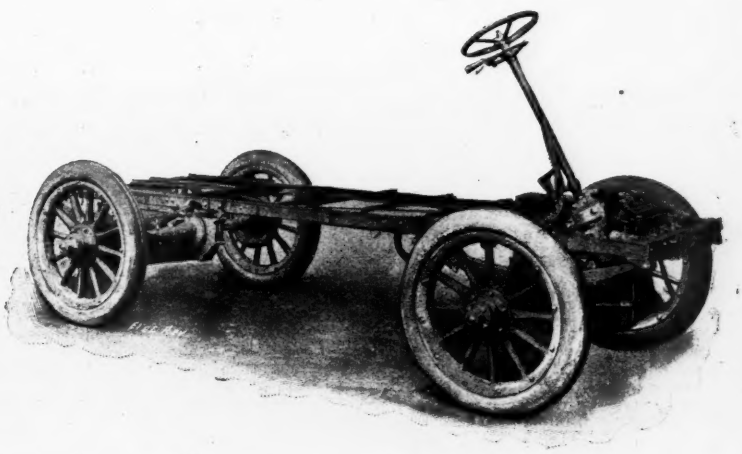
A prominent feature of the show and one of more than ordinary interest to the tramway engineer, is the fine array of motor-omnibuses by several well-known makers. Among these we noticed Messrs. Clarkson's well-known steam omnibuses, including specimens of the types being supplied to the London Road Car Co. (double-deck) for service in the metropolis, and to the London and South-Western Railway Co.; Messrs. Straker and Squire's 'buses of similar type, but petrol driven, also for the Road Car Co. Messrs. Milnes-Daimler, Ltd., show vehicles designed for the Great Western Railway Co.; Messrs. Thornycroft show a 36-seated double-deck petrol omnibus; the Brush Electrical Engineering Co. exhibit a "one-man" double-deck petrol 'bus, arranged to be entirely under the control of the driver. The Maudslay Motor Co., Ltd., the Wolseley Tool and Motor Car Co., Ltd., the Motor Car Emporium, Ltd., and the Beaufort Motor Co, are also exhibitors of omnibuses, mostly of large size and petrol drive. These exhibits serve to forcibly remind one of the rapid advances made in the construction of this type of vehicle, and the very extended and competitive uses to which it will shortly be applied.

We can dismiss the industrial steam and petrol cars with the remark that nothing specially novel in design is in evidence; but we cannot pass over the very comprehensive marine section, comprising motor launches and boats of all types and sizes, without mentioning the great strides which this side of the industry is evidently making.

The 40-ft. steel torpedo launch exhibit of Messrs. Thornycroft is most prominent in this section, and seems to excite very general interest. Magneto-ignition systems appear to meet with increasing favour for all purposes to which the petrol engine lends itself, and they are prominent on many of the launch engines.

Turning to the exhibits of electrical vehicles, several well-known firms are present, and their productions leave little to be desired in the matter of quality. The Silvertown electric carriages shown by Messrs. W. & F. Thorn, deserve special mention, not only because of their association with the well-known Silvertown works, but also on account of the many novel and advantageous features which they contain. The Silvertown chassis is shown below; it is provided with two 2½-H.P. enclosed motors fitted on to the front and rear axles respectively. A four-wheel drive is thus obtained, giving great smoothness of running, and eliminating to a great extent the chances of skidding on greasy roads. The framework, springs and axles are of steel of the best quality, and the transmission is by enclosed spur gearing, giving an efficient and silent drive.

The prominent feature of the controller is that the current is never broken on the drum, but always automatically by a quick-break chopper switch fitted with carbon break, and situated at the end of the drum, this arrangement avoiding burnt segments and bad contacts. The switch is also independently operated by the brake-pedal, before any braking effect can take place, and is held open by a cam when the brake pedal is released, and until the controller handle is brought back to the neutral position, when the switch once more closes in readiness for the next movement



The Silvertown Chassis; Four Wheels Driven.

of the controller handle. This arrangement acts as a safeguard against accidental starting of the vehicle.

The controller provides eight forward, five brake, and five reverse positions, all controlled by a handle placed under the steering wheel; the speed range is from about 1½ to 15 miles per hour.

The brake mechanism consists of phosphor-bronze brake shoes, which are expanded on the inside of the rims of two steel drums, the latter being rigidly fixed to the hubs of the two rear wheels. This brake is sufficient to hold the car on the steepest gradient, and the electrical brake provides a convenient method of regulating speed when descending a hill, or of pulling up dead, in cases of emergency.

In the carriage exhibited, a double landaulet (see figure on p. 291), the battery, consisting of 44 cells, is arranged half over the rear axle, and half under the driver's seat, this distribution of weight giving a more uniform life to the tires.

The carriage body was built by Messrs. W. & F. Thorn, of Lower Grosvenor Street, S.W., and is an excellent specimen of its kind. The vehicle is designed to run 35 miles on one charge on level roads, and should render excellent service for town work.

Messrs. Mors, Ltd., of Shaftesbury Avenue, agents for the Compagnie Française de Voitures Electromobiles, show a selection of electrical carriages of French make. In the construction of the chassis of these vehicles, forged steel plays a prominent part. An electric motor of special design is fitted in the front of the vehicle, and transmits motion to the rear axle through a chain drive and horizontal shaft, the latter being provided with a universal joint and a ball-bearing sleeve, allowing free movement of the back axle.

The electric motor is provided with two fields and two armatures, which allow of four speeds without altering the battery connections, all the cells remaining in series the whole time. The controller gives four speeds forward and one reverse, also an electric brake, all operated by a single lever.

(*To be continued.*)

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"Contractor" writes:—"A requires a building erected, which is to be fitted for electric light. He calls for separate estimates. B is accepted for the building and C for the electric light. B's men, during the course of erection, turned on the water and, as the pipes were not finished, the place was flooded and a great deal of C's work spoiled. Who is responsible to C—A or B?"

*** It is presumed that the damage occasioned to the fittings, &c., erected by C will necessitate much of his work being replaced. A must pay C for what he has done, as C would have no direct remedy against B. But if A finds it necessary to have any part of C's work re-done in consequence of the damage caused by the escaping water, he will be at liberty to claim the extra cost by way of special damage from B.

"Furnace" writes:—"I shall esteem it a favour if you will give me any information you can on the following point:—A gentleman proposes to lay down on his own private ground a light electric railway, for conveying the public a distance of half-a-mile without intermediate stops. The line would be fenced and the public would have no access to it except at terminal stations. Is it necessary by law (apart from any consideration of electrical advantages) to "bond" and "earth" the rails, which would be used as a return for the current? Are there any Board of Trade or other regulations governing such an installation, and, if so, where can a copy be obtained?"

*** So far as can be ascertained there is nothing to prevent a man constructing a railway on his own land in the manner suggested by "Furnace." In view of the fact that it is to be used for public purposes, it is conceived that due regard must be had to the Board of Trade regulations. Model regulations with respect to such railways were first made in March, 1894, and were revised in April, 1903. A copy of such regulations will probably be supplied by the Board.

"K.V.A." writes:—"I should be glad if you would kindly inform me whether there is any clause in the Electric Lighting Acts rendering it obligatory for an Electric Supply Authority (in this case an Urban District Council) to give notice to the local gas company of its intention to open roads for the purpose of laying mains, services, &c."

*** The form of provisional order which is to be found in the Schedule to the Electric Lighting (Clauses) Act, 1899, makes it quite clear that notice must be given to the gas company. It is there provided (by Sec. 18) that where the undertakers require to dig or sink any trench for laying down any new electric lines or other works near to which . . . . any work belonging to any gas . . . . company has been lawfully placed, ... the undertakers shall . . . . give to the gas . . . . company . . . . not less than three days' notice before commencing to dig or sink such trench . . . . and shall conform with such reasonable requirements as may be made by the owners or the officer, and shall if required by the owners thereof repair any damage that may be done.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

29,082A. 1904. "Improvements in the means for the mutual electrical control of oppositely rotating members of turbines." J. H. Davies and M. Blieden. (Date applied for under Patents Rule 9, December 30th, 1904.) January 31st.

22,826A. 1904. "Improvements in controllers for electric current." P. M. Justice. (The Voltage Controller Co., United States.) (Date applied for under Patents Rule 9, October 17th, 1904.) February 1st. (Complete.)

22,826B. 1904. "Improvements in electricity transmission systems." P. M. Justice. (The Voltage Controller Co. United States.) (Date applied for under Patents Rule 9, October 17th, 1904.) February 1st. (Complete.)

1,792. "Improvements in electric arc lamps." J. D. F. Andrews. January 30th.

1,820. "Improvements in or relating to electro-dynamic traction systems." J. Dulait, C. Zelenay and L. Rosenfeld. January 30th. (Complete.)

1,887. "Improvements in the electrolytic production of metallic sheets, tubes, wire, strip, or the like." S. O. Cowper-Coles. January 30th.

1,863. "A new or improved method and arrangement for enclosing cables, electric wires or the like." H. Rosner. January 31st. (Complete.)

1,868. "Improvements in electric lampholders and the like." A. Eckstein and A. J. D. Krause. January 31st.

1,876. "Improvements in apparatus for controlling the working of electrically-driven cars." F. Lydall. January 31st.

1,878. "Telephony." E. A. Buell. January 31st. (Complete.)

1,886. "Electric system of fog signalling." A. B. Dawson-Moray and J. F. Fitzsimons. January 31st.

1,891. "Improvements in contact-breakers of induction coils." M. A. Codd. January 31st.

1,919. "Brush-holder for dynamo-electric machines." J. Burke. January 31st. (Complete.)

1,920. "Laminated cores for dynamo-electric machines." J. Burke. January 31st. (Complete.)

1,921. "Dynamo-electric machines." J. Burke. January 31st. (Complete.)

1,943. "An improved suspension device for electric lamps and the like." A. Gunther, jun. January 31st. (Complete.)

1,951. "A new or improved system of automatic block signalling for electric railways." F. Townsend. January 31st. (Complete.)

1,966. "Improvements in or appertaining to mechanically or electrically propelled road vehicles." J. W. Allison. February 1st.

1,968. "An electric carrying lamp." F. G. Bucher. February 1st.

2,001. "Improvements in apparatus for the agitation of solutions and the like used in electro-deposition of all metals." W. C. Wood and B. Oakford. February 1st.

2,004. "Improvements in or relating to electric vapour lamps or enclosed arc lamps." C. O. Bastian and G. Calvert. February 1st.

2,014. "Improvements in or relating to electric distribution systems." A. J. Boult. (J. B. Entz, United States.) February 1st. (Complete.)

2,015. "Improvements in or relating to brush-holders for electric dynamos or motors." L. C. Barker and J. W. Burleigh. February 1st.

2,022. "Improvements relating to electric accumulators or secondary batteries." Vickers, Sons & Maxim, Ltd., and R. F. Hall. February 1st.

2,030. "Improved method and means for eliminating or reducing the influence of disturbing currents on telephone circuits." C. M. Jacobs. February 1st.

2,039. "Improvements in electric meters." The British Thomson-Houston Co., Ltd., and F. Holden. February 1st.

2,040. "Improvements in windings for dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 1st.

2,066. "Improvements in automatic controlling apparatus for operating electric switches or cut-outs." C. M. Dorman, R. A. Smith, and H. G. Baggs. February 2nd.

2,098. "Improvements in brush-holders for dynamo-electric machines." J. W. Burleigh. February 2nd.

2,108. "Improvements relating to intercommunication telephone systems." J. Young. February 2nd.

2,113. "Improvements in combined overload and reverse-current cut-outs." The British Thomson-Houston Co., Ltd., and E. B. Wedmore. February 2nd.

2,116. "Improvements in alternating current motors." V. A. Fynn. February 2nd.

2,159. "An automatic electric portable signal." H. Wallace. February 3rd.

2,172. "Improvements in or relating to electric traction systems." W. S. Boult. February 3rd.

2,180. "Improvements in single-phase indication motors." The Akt.-Ges. Brown, Boveri & Co. February 3rd. (Date applied for under Patents Act, 1901, February 4th, 1904, being date of application in Switzerland.) (Complete.)

2,188. "An improved form of contact breaker for induction coils and the like apparatus." A. H. Avery. February 3rd.

2,187. "An improved safety lock with an electric warning device and detonator." L. A. Aidibert. February 3rd. (Complete.)

2,190. "Improvements in starting switches for electric motors." W. A. Clatworthy, A. Holmes, J. H. Holmes, L. W. Holmes, and E. Holmes. February 3rd.

2,194. "Improvements in inspection boxes for electric light leads and the like." J. Wenham. February 3rd.

2,264. "Improvements in and connected with means for generating electricity from heat." W. A. Turner. February 4th.

2,266. "Improvements in the construction of spring jacks for telephone switchboards." Siemens Bros. & Co., Ltd. (Siemens & Halske Aktien-Gesellschaft, Germany.) February 4th. (Complete.)